The Design Of The Dentists' Chair

by

Eoin Mac Hale

B.Des. 1997

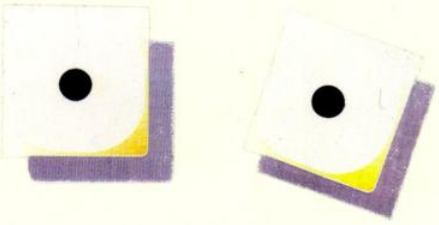
The Design Of
The Dentists' Chair

by

Eoin Mac Hale

B.Des.

1997



National College of Art and Design,

Faculty of Design,

Department of Industrial Design.

The Design Of

The Dentists' Chair

by

Eoin Mac Hale.

Submitted to the Faculty of History of Art and Design and Complementary Studies

in Candidacy for the Degree of

Bachelor of Design

1997.

Acknowledgements:

I wish to acknowledge the assistance of the following:

Ahrends, Burton and Koralek (A.B.K), Architects of the Dublin Dental Hospital, T.C.D.;
Anne M. O' Byrne, Librarian - Dublin Dental Hospital;
Mr D. Clarke, Engineer - Dublin Dental Hospital;
Dr John Dermody, Dublin;
Mrs Sheila Doherty,
Mr Paul de Freine, Architect Director at A.B.K., Dublin;
Dr Barry Harrington, Director of Clinics, D.D.H;
Image Magazine, Dublin;
Harvard Medical Library, Boston;
Dr Joan MacHale, Sligo;
Massachusetts Historical Society, Boston;
Planmeca- dental chair manufacturer, Finland;
Prof. D.B. Shanley, Dean of Dentistry, T.C.D.;

My thesis supervisor Dr Paul Caffrey and the staff of N.C.A.D. Library.

CONTENTS

Title	Page
Acknowledgements	2
List of Illustrations	5-9
Introduction	9-14
Chapter 1. From Dental Chair to Dental Unit . .	14-26
Chapter 2. Furniture Design - Domestic and Dental	26-34
Chapter 3. Case Study - S.S. White Company U.S.A.	34-43
Chapter 4. Streamlined Dental Units - Interplay with furniture design.	43-55
Chapter 5. Contemporary Dental Surgery Layout .	55-66

Chapter 6.(I) Case Study - Planmeca, Finland 1996.
(II)Case Study -A.B.K. Architects . . 66-85

Chapter 7.Conclusions and Possible Future Trends- learning from the past. . 85-96

Appendix A 96-116
-Planmeca's technical data on the Prostyle Compact Dental Chair.

Appendix B 116-125
-Planmeca Company, Finland, promotional Literature.

Appendix C 125-127
-A.B.K. Architect's plans for interior design of new Dublin Dental Hospital.

Bibliography. 127-131

List of Illustrations

Figure	Illustration	Page
Fig. 1	Hand bill for Josiah Flagg (first American dentist).	15
Fig. 2	Windsor chair.	16
Fig. 3	First dental chair.	17
Fig. 4	Upholstered German dental chair (1890s).	18
Fig. 5	Archers no. 2, Swan chair.	19
Fig. 6	Morrison's tilting dental chair.	20
Fig. 7	Hayes dental chair.	20
Fig. 8	Dr Blacks' surgery- circa 1885.	22
Fig. 9	Italian dental cabinet	21
Fig. 10	Rotating dental cabinet, 1905	23
Fig. 11	Dental unit- circa 1940.	24
Fig. 12	Water driven dental drill.	25
Fig. 13	Unit kitchen.	29

Fig. 14 - Unit study. 29

Fig. 15 - Fibreglass shell armchair by Eames. 32

Fig. 16 - The lounge chair and ottoman by Eames. . . . 33

Fig. 17 - S.S. White Company New York depot. . . . 36

Fig. 18 - Dental Cosmos published by S.S. White, 1931. . . 37

Fig. 19 - Whitcomb's dental fountain spittoon. 38

Fig. 20 - The first electric dental drill. 39

Fig. 21 - Morrison's foot operated dental drill. 40

Fig. 22 - Dr E. Kells- first to electrify a surgery. 40

Fig. 23 - Baltimore dental office 1900, with example of first all-metal dental chair. 41

Fig. 24 - Four-handed dentistry. 45

Fig. 25 - 1970s streamlined surgery. 46

Fig. 26 - Osuoldo Borsani's chaise-lounge (model P.40). . . 48

Fig. 27 - Le Corbusiers' chaise-lounge c. 1928. . . . 50

Fig. 28 - Le Corbusiers' chaise-lounge c. 1928. . . . 50

Fig. 29 - Ron Arad chair. 52

Fig. 30 - Ron Arad chair. 52

Fig. 31 - Dental chair as domestic furniture. 54

Fig. 32 -Dublin Dental Hospital / School. 57

Fig. 33 - Baltimore Dental School. 58

Fig. 34 - Sterling dental chair. 59

Fig. 35 - Sterling dental chair. 59

Fig. 36 - Standing position of dentist- common up to 1950s. . 60

Fig. 37 - Livingstone dental chair with Sterling base. . . 62

Fig. 38 - 1985 Siemens dental chair head-rest. . . . 63

Fig. 39 - Siemens dental chair. 63

Fig. 40 - The 1994 Siemens dental chair. 64

Fig. 41 - Prostyle Compact dental unit. 65

Fig. 42 - Proline PM 2002 dental unit. 68

Fig. 43 - Prostyle Compact Chair- cantilever base. . . 69

Fig. 44 - Dimensions of Prostyle Compact.. 71

Fig. 45 - Siemens foot pedal (1980s design). 70

Fig. 45(a) - Prostyle Compact foot control. 70

Fig. 46 - Prostyle Compact spittoon. 73

Fig. 46(a) - Wendell Castle chair, 1970. 73

Fig. 47 - Dublin dental surgery.. 74

Fig. 48 -Sligo dental surgery. 75

Fig. 49 -Dental stool in Dublin Dental Hospital. . . . 77

Fig. 50 - Vertebra Office Chair 1978, by Castelli. . . . 78

Fig. 51 - New Dublin Dental Hospital under construction. . . 80

Fig. 52 - Mock-up of new Dublin Dental Hospital dental cubicle with Prostyle Compact dental chair in position. . . . 81

Fig. 53 - First cantilever chair by Stam, 1926. . . . 87

Fig. 54 - Van der Rhoe's chaise-lounge, 1931. . . . 88

Fig. 55 - The worlds lightest chair. 92

Fig. 56 - Dentek LD15 laser. 93

Introduction

> Since the beginning of civilisation humans have required something to sit on - and as societies evolve, so does the chair (Fiell, 1993, p.7).

Today the evolution of chair design is frequently driven by specialised requirements. The enduring success of a particular chair can be evaluated by how skilfully its creator has synthesised aesthetics and function while addressing a specific need. Is this demonstrated in the evolution of the dental chair and the emergence of design in dentistry? This thesis aims to answer the above question - with particular reference to the dental chair. Research involved a wide range of sources (as this was a previously unexplored area) - the most important of which were several visits to Dublin Dental Hospital staff and A.B.K. architects London. Information from the Dean of Dublin Dental Hospital, Professor D.B. Shanley, The Director of Clinics, Dr B. Harrington and many other experts in their chosen fields of engineering etc. combined with the collection of promotional literature and data from Planmeca, Finland and S.S. White Co., U.S.A. provided the basis for discussion throughout the entire thesis.

Chapter one is concerned with tracing briefly the origins of the dental chair in the USA from 1790 where dentistry first emerged as a profession. This country remains the world leader with regard to advances in dentistry today and therefore much of this thesis is from an American perspective.

The second chapter investigates the influence of new technology and materials on the evolution of period furniture to modern style in the USA from 1930 onwards. It draws on texts such as Horizons (Bel Geddes, 1932) Design Since 1945 (Dormer, 1993) and Modern Furniture Classics (Fiell, 1991) which are essential and clear reading on furniture design, and points out the development of industrial design as a profession.

Still focussing on the USA, chapter three is concerned with the many contributions made by S.S. White Co. from 1843 to the present day. It presents an overview of some of the pioneering designs produced by this dental manufacturing company which promoted rapid advances in dentistry worldwide.

Literature Survey

The book Dentistry: An Illustrated History (Ring, 1985) is invaluable in providing much of this basic dental historical information. The healing art of dentistry has a long and

distinguished history. This unique book documents all the important developments relevant to the emergence of the dental chair and profession. In a very illuminating way, it provided essential background knowledge and yielded many insights quite specific to the subject of this thesis.

Reading Modern Chairs (Fiell, 1993) and Modern Furniture Classics (Fiell, 1991) gives one an appreciation of the revolutionary transformations of the chair over the last century, due to developments in manufacturing techniques, materials and indeed war. Design Since 1945 (Dormer, 1993) presents an interesting account of the history of industrial design over the last half century. The Modern Chair (ICA , 1988) is an excellent text focusing on the ramifications of chair design over the last one hundred years. All five books mentioned above coupled with literature from Planmeca- (dental chair manufacturers, based in Finland) enabled the author of this thesis to realise the parallels and crossovers between dental chair design and many other types of chair design as the two developed supposedly independently of each other, influenced by different elements along the way.

With regard to future trends, the viewpoint of forward minded people had to be examined. Horizons (Bel Geddes, 1932) is a wonderful example of one such future vision from a nineteen

thirties (industrial design) perspective enabling one to examine the predictions made with the benefit of hindsight. Engines Of Creation (Drexler, 1990) provided a contemporary futuristic viewpoint for comparison with Bel Geddes's book and also to apply to the field of dental design in the coming years.

The fourth chapter contains a review of streamlining and examines the interplay between dental and furniture design. A clear link is highlighted between the sleek shape of modern dental chairs and domestic chairs, which raises the interesting point that the dental chair - initially influenced by domestic furniture design - has now been domesticised (taken from the dental surgery to the living room).

Chapter five concentrates on Dublin Dental Hospital with its wide selection of dental chairs encompassing many periods. The evolution of design in dentistry is charted, using many examples chosen from Dublin Dental Hospital

The sixth chapter consists of two parts: firstly, a case study of Planmeca, Finland - the company supplying Dublin Dental Hospital with eighty new dental chairs; secondly, a report on A.B.K. Architects, London, the firm employed to design the surgery work surfaces and storage units of the new Dublin

Dental Hospital - a first for design in dentistry anywhere in the world. As background to this report, it was necessary to trace the origins of purpose-built, modular office furniture in the second half of this century.

The final chapter (seven) draws conclusions from all the research and questions raised in previous chapters. Most notably, it is apparent that dental chair design has lagged behind furniture design. (Planmeca's Prostyle Compact dental chair is chosen as an example to illustrate this conclusion). Part of the reason for this is attributed to the relatively low percentage of industrial designers involved in dental manufacturing- especially outside the USA. The chapter ends by identifying possible future trends with regard to design in dentistry. The standardisation of dental surgeries is envisaged with modular systems furniture on a mass produced scale.

Greater involvement of the industrial designer in dental manufacturing (specifically with regard to the dentist's stool) will ensure that the very specific needs of both patient and dentist are addressed, while providing aesthetics and function. Combined with the influence of new materials and technology, design in dentistry looks set to lead the way into the 21st century.

Chapter

(1)

From Dental Chair to Dental Unit (1790 - 1900).

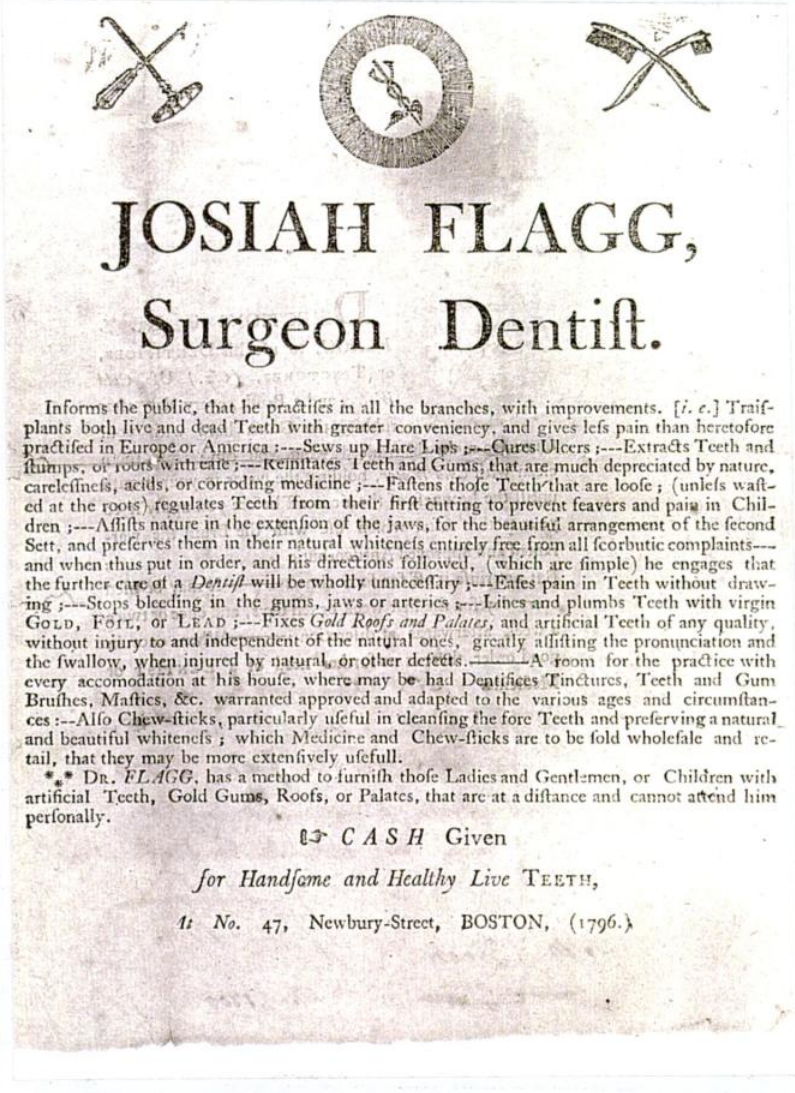
-A brief overview.

In 1873 Dr Christopher Dresser wrote:

> "A chair is a stool with a backrest and a stool is a board elevated from the ground by supports" (Fiell, 1993, p.7).

The First Dental Chair

This development is attributed to Josiah Flagg, the U.S.A.s first native, full-time dentist (Figure 1).



JOSIAH FLAGG,

Surgeon Dentiſt.

Informs the public, that he practiſes in all the branches, with improvements. [*i. e.*] Traiſplants both live and dead Teeth with greater conveniency, and gives leſs pain than heretofore practiſed in Europe or America :---Sews up Hare Lips ;---Cures Ulcers ;---Extracts Teeth and ſtumps, or roots with eaſe ;---Reinſtates Teeth and Gums, that are much depreciated by nature, careleſſneſs, acids, or corroding medicine ;---Faſtens thoſe Teeth that are looſe ; (unleſs waſted at the roots) regulates Teeth from their firſt cutting to prevent feavers and pain in Children ;---Aſſiſts nature in the extenſion of the jaws, for the beautiful arrangement of the ſecond Sett, and preſerves them in their natural whiteneſs entirely free from all ſcorbutic complaints---and when thus put in order, and his directions followed, (which are ſimple) he engages that the further care of a *Dentiſt* will be wholly unneceſſary ;---Eaſes pain in Teeth without drawing ;---Stops bleeding in the gums, jaws or arteries ;---Lines and plumbs Teeth with virgin GOLD, FOIL, or LEAD ;---Fixes *Gold Roofs and Palates*, and artificial Teeth of any quality, without injury to and independent of the natural ones, greatly aſſiſting the pronunciation and the ſwallow, when injured by natural, or other defects.---A room for the practice with every accomodation at his houſe, where may be had Dentifices Tinctures, Teeth and Gum Bruſhes, Maſtics, &c. warranted approved and adapted to the various ages and circumſtances :--Alſo Chew-ſticks, particularly uſeful in cleanſing the fore Teeth and preſerving a natural and beautiful whiteneſs ; which Medicine and Chew-ſticks are to be ſold wholeſale and retail, that they may be more extenſively uſefull.

*** DR. *FLAGG*, has a method to furniſh thoſe Ladies and Gentlemen, or Children with artificial Teeth, Gold Gums, Roofs, or Palates, that are at a diſtance and cannot attend him perſonally.

☞ *CASH* Given

for Handſome and Healthy Live TEETH,

At No. 47, Newbury-Street, BOSTON, (1796.)

Figure 1
This hand bill of 1796 is an advertisement for Josiah Flagg- America's first native- born, full-time dentist. (From Ring,1985, p.194).

Up until the early 1800s, dentistry was a sideline for barbers-

hence the name barber-surgeons. In 1790, Flagg invented the first dental chair from the Windsor chair- with adjustable headrest and arm extension to hold instruments. The Windsor chair is very adaptable (Figure 2 & 3).

Figure 2
The Windsor chair.

Figure 3
Note the adjustments made to the Windsor chair- adjustable head-rest and arm extension for instruments- invented by Josiah Flagg in 1790. (From Ring, 1985, p. 195).

There are many variations of the Windsor chair- including folding chairs, revolving office chairs, arm chairs, rocking chairs, stools and benches.

> Many of these commercially produced chairs have the simplicity, usefulness, and gracefulness that give them the character of modern design. (Schiefer, 1970, p.10)

Early Dental Chairs (1840 - 1890)

For many years, dentists continued to use ordinary kitchen chairs, to which were attached a portable headrest introduced by Jones White & company in 1847. There were more specific designs. James Snell made the first reclining dental chair in 1832. This was upholstered and had a lamp and mirror arranged to reflect light into the mouth. Full dental chairs were manufactured by a number of companies in the 1850s and 1860s- in walnut, rosewood or mahogany. These recliners were upholstered in plush including a footrest (figure 4).

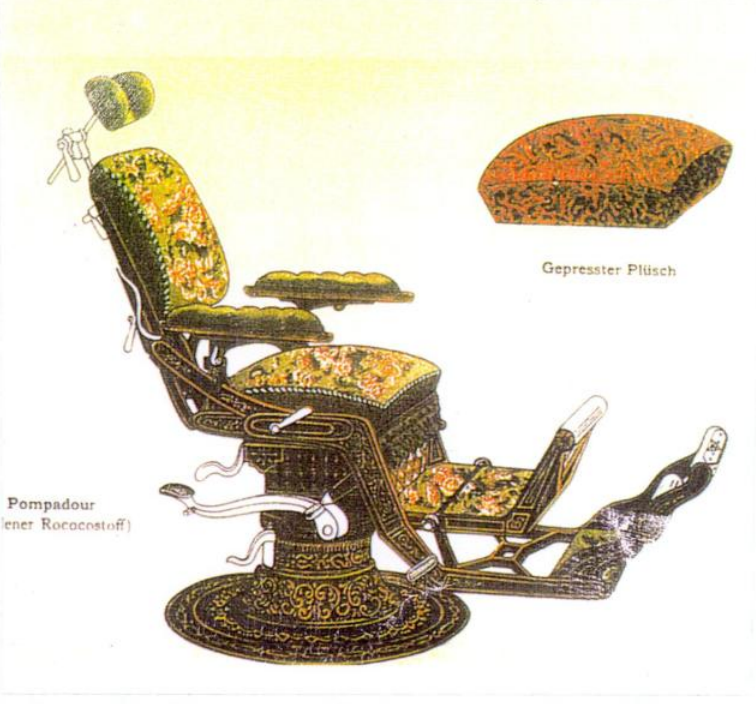


Figure 4
This richly upholstered 1890s German dental chair could be raised or lowered by means of foot pedal. (From Ring 1985, p. 252).

The Swan chair- so called because the arms were carved to resemble a swan's neck- is an example. (See figure 5).

Figure 5
Circa 1870, patient seated in an Archer's Swan chair. Note twin dentists or trick photography? (From Ring, 1985, P.254).

In 1868, James Beall Morrison designed a unique dental chair that tilted in any direction. However only four were made (figure 6). In 1875, the Buffalo Dental Manufacturing Company produced the Hayes dental chair. (Figure 7).

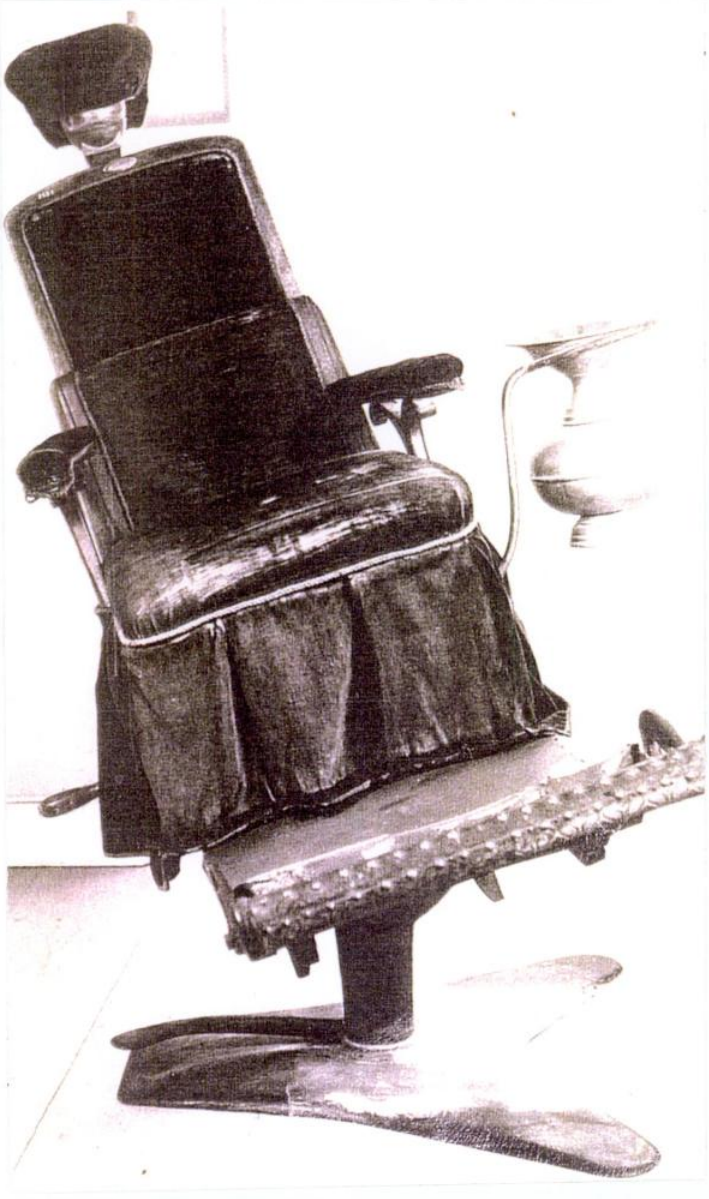
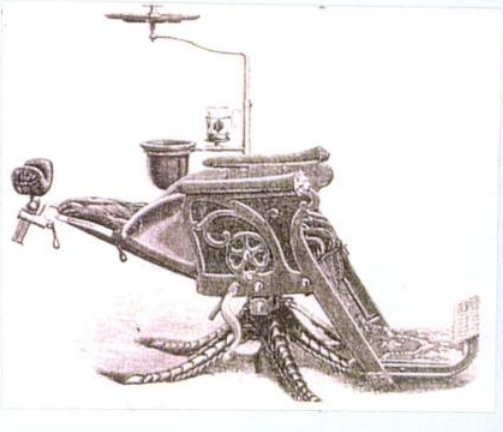


Figure 6
(From Ring, 1985, p.255).

Figure 7
(From Ring, 1985, p.255).



This reclined fully so that the dentist could sit while working. But most stood while working until the 1950s.

Nineteenth Century Dental Surgery Layout

However the dental unit of today still didn't exist in the late 1800s. Dentists instead used a bracket table for instruments which was fastened to a wall by an extendible arm. This table was often fitted with tiny drawers for burs and other small pieces of equipment. Furniture included a desk, since a separate business office had not yet become standard. (Figure 8, over-leaf). Most dental surgeries of this period contained one or more dental cabinets to hold instruments etc. Dental cabinets under went many changes and some very beautiful models were manufactured in oak and mahogany - made in a variety of sizes so that they could be placed in a variety of places in an office (figure 9).

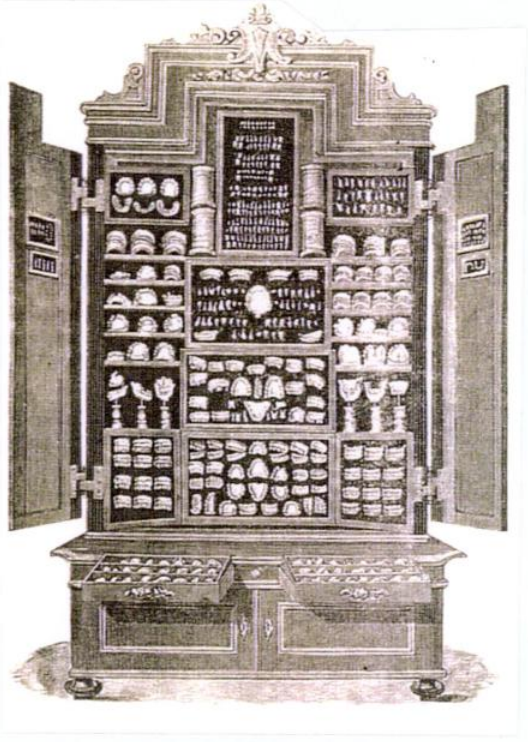


Figure 9
A dental cabinet from Italy 1876.
(From Ring, 1985, p.259).

Figure 8

Dr G. V. Black's operating room in Jacksonville, Illinois, about 1885. (From Ring, 1985, p.253).

One ingeniously constructed octagonal model rotated on a stationary base, occupying a minimum of space, yet offering enough drawers for all the materials and medicines that were by then available to the profession. It was patented in 1905. It had twelve drawers, five cupboards, two medicine cases, six swinging drawers and two forceps compartments (figure 10).

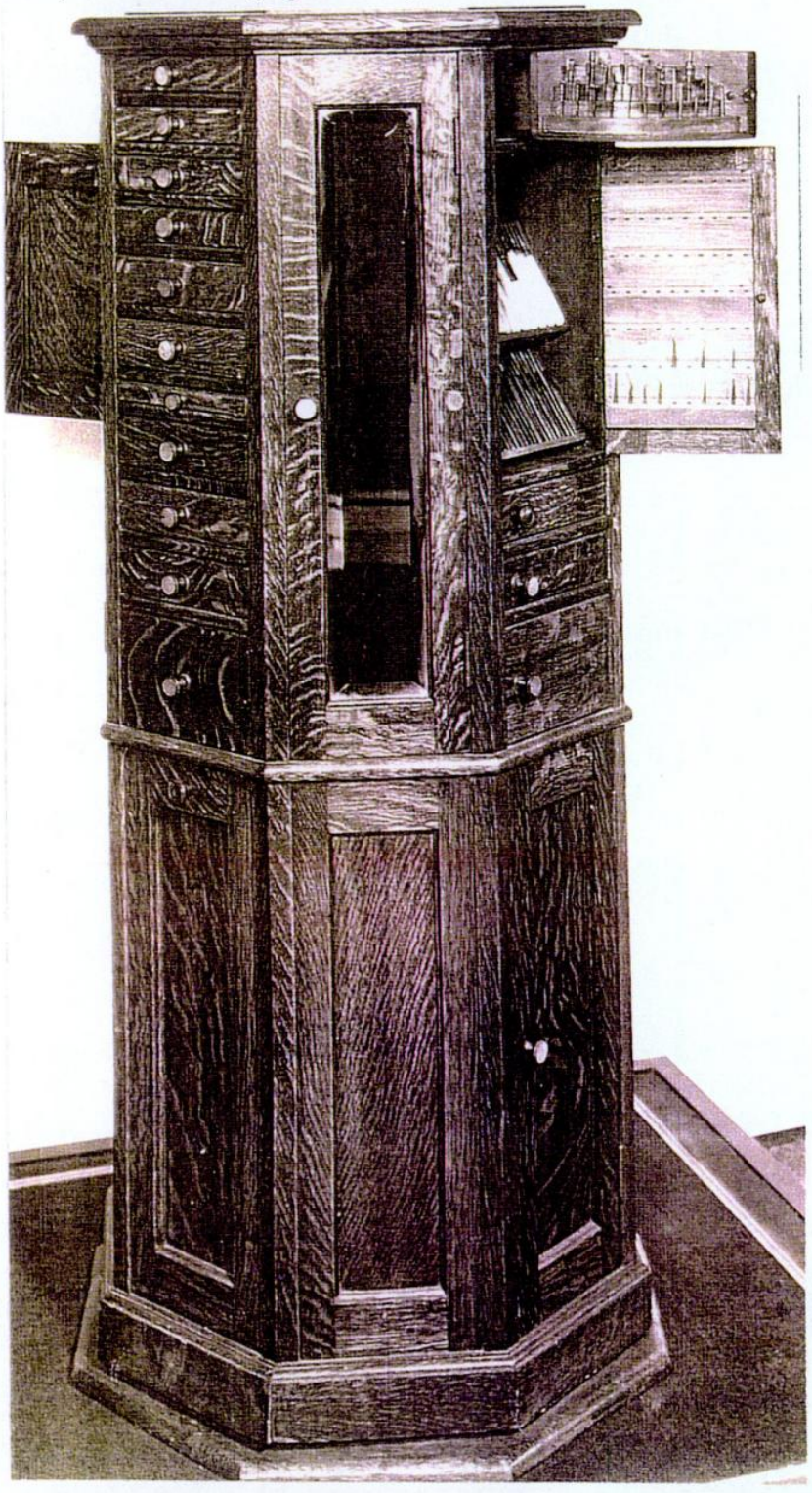


Figure 10

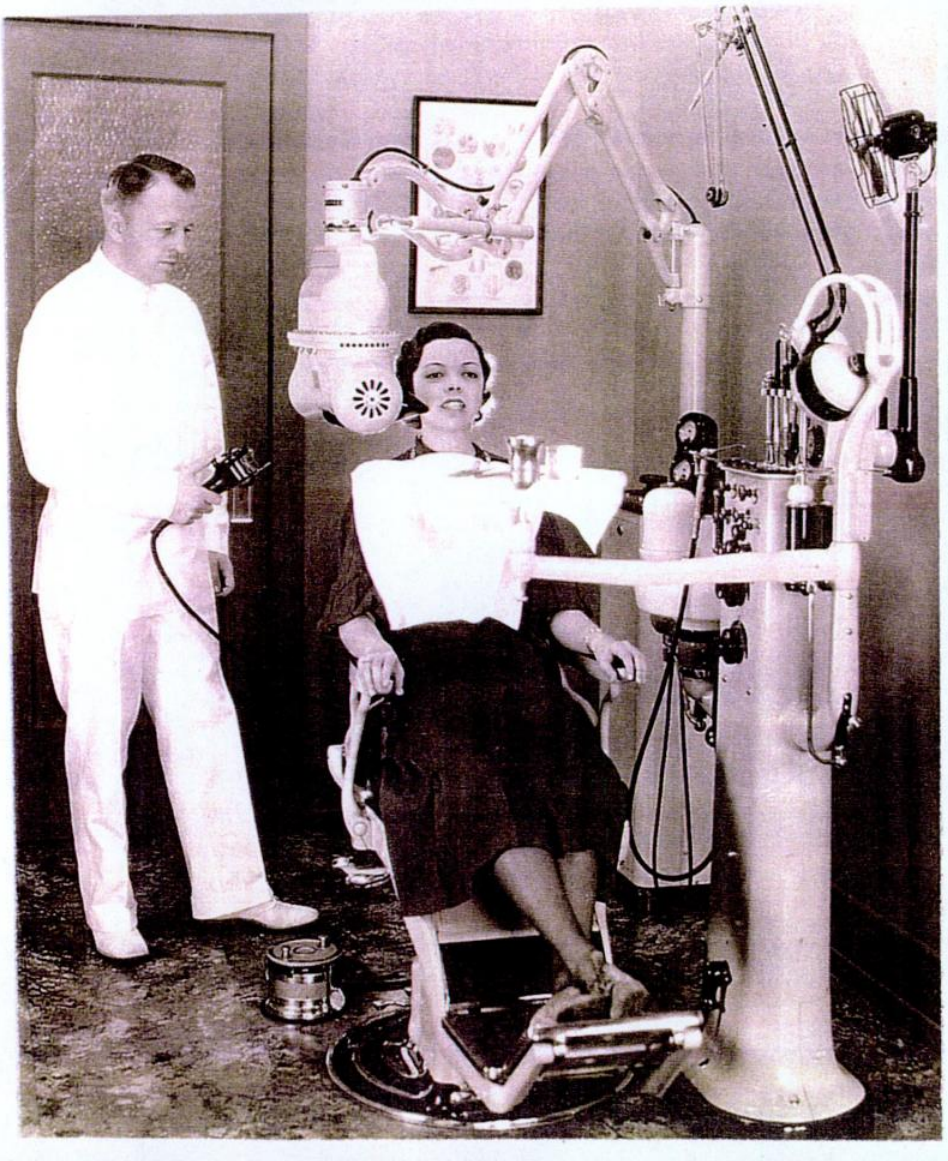
A rotating dental cabinet patented in 1905. (From Ring, 1985, p.258).

Until electricity became common in offices, at the turn of the century, dental treatment was performed during daylight only, with the patient seated facing a window. Items of equipment and office furniture, plus a wash basin of sorts, constituted all that would be found in an average dental surgery of the period, see figure 8.

Some Notable Changes in Dental Surgeries from 1900.

The dental unit combined many elements in a single piece of equipment - chair, light, drill, air blower, spittoon etc. Its development in the early 1900s marked a great increase in efficiency (figure 11).

Figure 11



The dental unit, chair and x-ray machine seen in this well equipped office of 1940 were made by the Ritter Company of Rochester, New York. Note that the profession was not yet fully aware of the dangers of radiation, with the dentist standing too close to the x-ray machine and the patient wearing no protective lead apron. (From Ring, 1985, p.307).

Chapter three focuses on many of the innovations manufactured by S.S. White Company that revolutionised dentistry firstly in America, and later, worldwide. Apart from advances in dental chair design and the advent of the turbine drill (figure 12), (which is detailed in chapter three), other changes occurred to modernise dentistry.

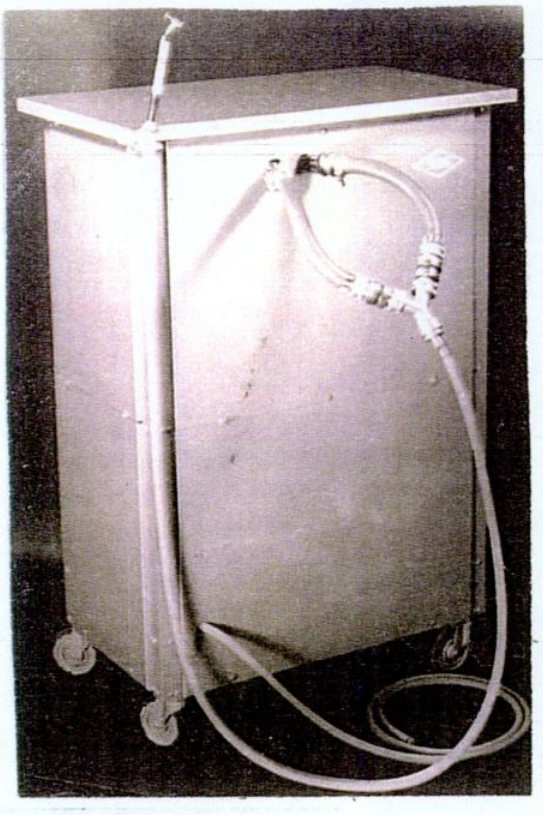


Figure 12
This water driven dental drill, the first all-turbine model, came on the market in the 1950s. The invention of Dr. R. J. Nelson, the Turbojet could achieve speeds of 16,000 rpm. (From Ring, 1985, p.307).

By the early 1920s most dentists had x-ray machines, and sterilisers were to be found in almost every dental office. Today, the autoclave has almost universally replaced the old -fashioned steriliser containing boiling water. At the end of World War Two, a new dental ortho pantomograph x-ray was introduced which allowed radiographs of both jaws on one film. Also, in post war decades there were changes in office procedure. With dental reception and waiting areas, the dental office became a separate entity to the dental surgery.

Chapter

(2)

Furniture Design- Domestic and Dental.

-A review of the influence of new technology and materials on the evolution of period furniture to modern style in the USA (1930 onwards).

New Materials And Methods In Furniture Design.

A number of industrial designers including Gilbert Rhodes and Russell Wright started working with mass production companies in the 1930s to ensure that cheap modern furniture could be made available to the consumer. In 1930s America, the biggest impetus for change, both in reproduction and modern pieces, was in the use of new materials and techniques to keep costs down. Interest in new materials was fundamental to American design and manufacturing during this decade. Rubber, veneers, aluminium, glass, formica, linoleum, cork and flexwood all found their way into furniture in one form or another. Flexwood wood-veneer mounted onto a flexible canvas backing was used to cover walls, for example. Veneer-covered laminated wood was also increasingly used for cabinets and table construction in order to allow cheap standardised production. Other materials such as glass, cork, asbestos and aluminium were introduced mainly as new alternative to wood. In 1933, the Howell company in Geneva, Illinois, first mass-produced furniture in tubular steel.

New Styles Of American Furniture.

In 1936, two styles of American furniture were identified:
(1) Classic Modern, which depended upon occasional borrowing from period styles and

(2) Functional, e.g. Rhode's designs for the Kroehler Manufacturing Company based in Chicago.

This Functional style was characterised by flat smooth surfaces - a formal simplicity influenced by the fashion of streamlining evident in car design. This functional modern style was promoted for its hygienic qualities (no cracks to conceal dirt). Aluminium, stainless steel and chrome were used for the fact that they retained their shine without the drudgery of polishing.

Unit Furniture In The U.S.A

Reduced incomes and smaller living quarters, led to the development of the unit idea, which had begun with steel cabinets and presses for the kitchen. Bel Geddes had great foresight and wrote in detail about standardised units for the kitchen, office and bathroom, in his book Horizons (1932) see figures 13 and 14 overleaf.

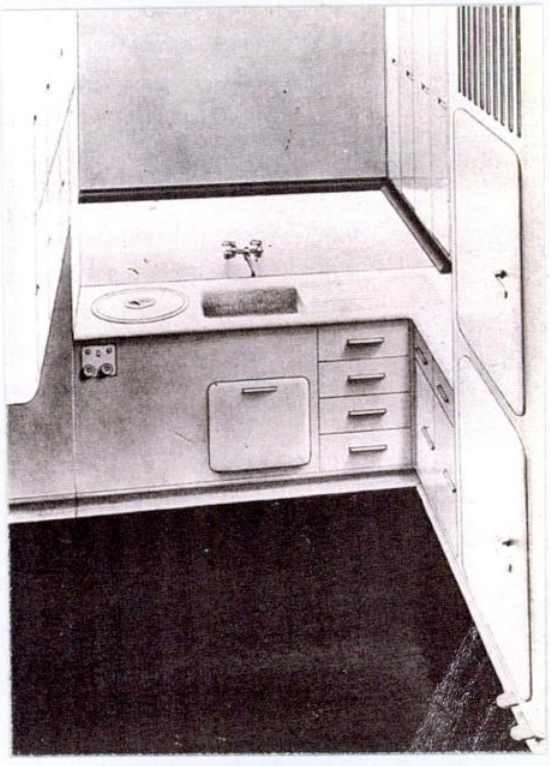


Figure 13

Unit Kitchen.
(From Bel Geddes, 1932, p.136).

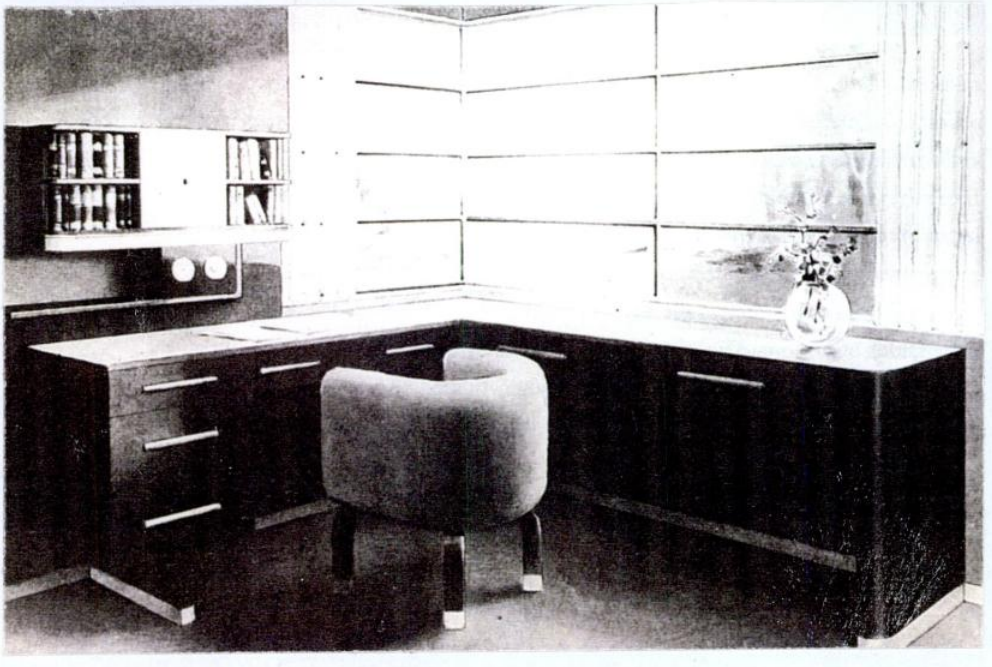


Figure 14
Unit study. (From Bel Geddes, 1932, p138).

He recognised the benefits with regard to coordinating architecture and design, economic advantages and ease of cleaning.

Gilbert Rhodes's furniture items - "Living- Dining- Sleeping" were produced by the Kroehler manufacturing company in the early 1930s. These units were designs to meet the needs of people living in modestly sized homes built in that decade.

The Rise of Organic Furniture in the U.S.A.

However, despite many advances in new technology, materials and design, it was only in the years after 1940 that it became possible, for the first time, to identify a modern furniture style with completely American origins. Then, due in part to new developments in new technology, a new generation of American designers made organic furniture - notably Eero Saarinen and Charles and Ray Kaiser Eames. These furniture designers were excited by the possibilities offered to them by new laminates, new bending techniques, and combinations of laminated wood metal and plastic. By making a means of moulding new materials in two directions at once (thus creating vessel, as well as valley forms), these modern furniture designers were able to switch from constructed assemblage to sculptural forms. These new organic, rounder designs appeared also in Italy and somewhat in Britain.

Saarinen and Eames established organic furniture as a style which grew out of new technologies in plastic wood and rubber lamination. They worked together on their designs for the "Organic Design in Home Furnishings Competition" held at the Museum of Modern Art, New York, (1940-1941). Lamination was used to create curves of much greater strength than the bent wood frames pioneered in the 19th century. It was advanced by the rapid investment into aircraft construction during the war, (especially propellers), and the development of synthetic bonding resins superior to animal glues.

Upholstery Materials

Rubber- especially foam and moulded rubber- changed the concept of upholstery. It could be used as an alternative to, or with metal springing. It enabled the creation of comfortable forms with a much thinner section than was afforded by traditional upholstery. However, plastics did not have much influence in furniture until the late 1950s.

Notable American Furniture Designs Since 1940.
(From Dormer, 1993, pp123-124).

Among the most famous single items of American furniture design between 1940-1960 are Eero Saarinen and Charles Eames's moulded plywood armchair, upholstered in wool (1940); Eero Saarinen's Lounge chair for G.M., tubular aluminium with brushed chrome finish, now upholstered in vinyl, (1950); Eero Saarinen's Womb chair, tubular steel with wool upholstery (1946-'48); Charles and Ray Eames' Fibreglass Shell armchair (1949) see figure 15.

Figure 15
(From Dormer, 1993, p.116)

Eero Saarinen's Pedestal table, steel with fused plastic finish pedestal, marble for the top (1955-'57); Charles and Ray Eames's Lounge chair and ottoman- legs and supports in steel with moulded rosewood, plywood and cast aluminium (1956) see figure 16. The welded steel Diamond - lattice chair created by Harry Bertoia (Italy - U.S.A., 1915-'78) in 1952 was one of the most famous post war chairs.

Figure 16
(From Fiell, 1993, p.80)

Chapter

(3)

Case Study - S.S White Company, USA.

-Dental Manufacturing (1843 to present day).

The American Look in furnishings and interior design was especially significant in the offices of Corporate America. Companies such as IBM, Ford, Coco-Cola and Du Pont were regarded as top examples of business efficiency and other companies worldwide wanted to copy their look of comfort, colour, brightness order and hygiene. The American consumer could choose his interior because many choices existed. Accordingly, the dental manufacturing industry made rapid advances following the new domestic and office furniture design.

S.S White Company- The Beginning.

Based in Philadelphia, Samuel S. White founded his own business in 1843, which eventually became the leading dental manufacturing company in the world (figure 17, over leaf). In 1846, White gave up his dental practice to devote his time to manufacturing and promoting new dental products and materials. Shortly after 1860, a monthly publication called Dental Cosmos (figure 18, over leaf) was first printed. It became the most influential dental magazine of all time. Its pages announced almost every major advancement in dentistry made through-out the world during the second half of the 19th century.

Figure 17
S.S. White supply house in New York City, one of many established in the nineteenth century in most major American cities and also abroad. (From Ring 1985, p. 205).

NEW YORK DEPOT.

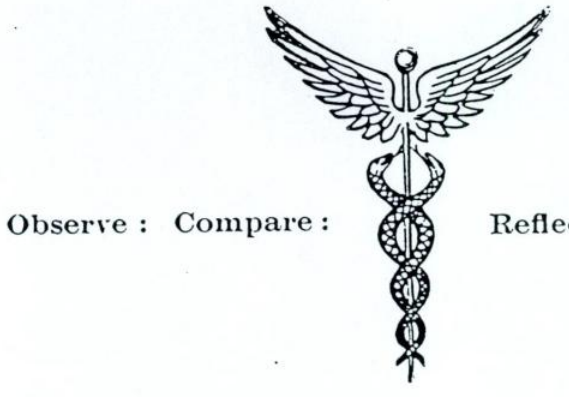
THE DENTAL COSMOS

A MONTHLY RECORD
OF DENTAL SCIENCE

Devoted to the Interests of the Profession

EDITOR

L. PIERCE ANTHONY, D.D.S., F.A.C.D.



Observe : Compare : Reflect : Record

VOLUME LXXIII—1931

PUBLISHED BY

THE S. S. WHITE DENTAL MANUFACTURING CO.

211 SOUTH TWELFTH STREET, PHILADELPHIA

1931

Figure 18
Courtesy of Ms. A. Byrne, Dublin Dental Hospital library, Trinity College, Dublin.

In 1871, Dr James W. White, brother of the publisher S.S White, became editor and held that post until his death in 1891. (After S.S. White's death in 1879, the S.S. White dental manufacturing company assumed the role of publisher). Dental Cosmos remained a force in the profession until 1920. Later, it merged with the Journal of the American Dental Association.

Innovative Products Manufactured By S.S. White Company.

Running water and electricity led to many inventions including that of Whitcomb's Dental Fountain Spittoon, the first self-cleansing cuspidor (which required modern plumbing). This was produced by S.S. White Co. in 1867 (see figure 19).

Figure 19
(From Ring, 1985, p.259).

The water was supplied through many perforations surrounding the bowl and drinking water flowed from the beak of a miniature swan perched daintily on a rod over the basin. The fountain spittoon made the modern saliva ejector a possibility. It was finally introduced in 1882. In 1872, S.S. White and company also put on the market the first electrically powered dental drill. This was invented by George F. Green, a mechanic they employed in 1868 (figure 20). The motor was incorporated directly into the hand-piece of the instrument which was very cumbersome. Over the next decade many improvements were made in the electric drill but most

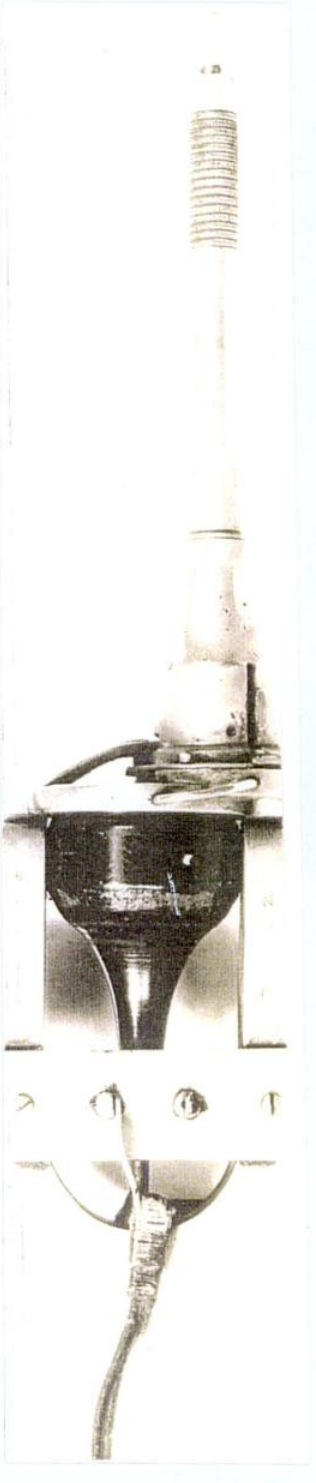


Figure 20

(From Ring, 1985, p. 251).

dentists continued to use the foot operated dental drill, manufactured also by S.S. White Company, because electrification was not widespread (Figure 21). Only in the late 1880s did Dr C. Edmund Kells become the first to bring electricity to his surgery. (Figure 22).

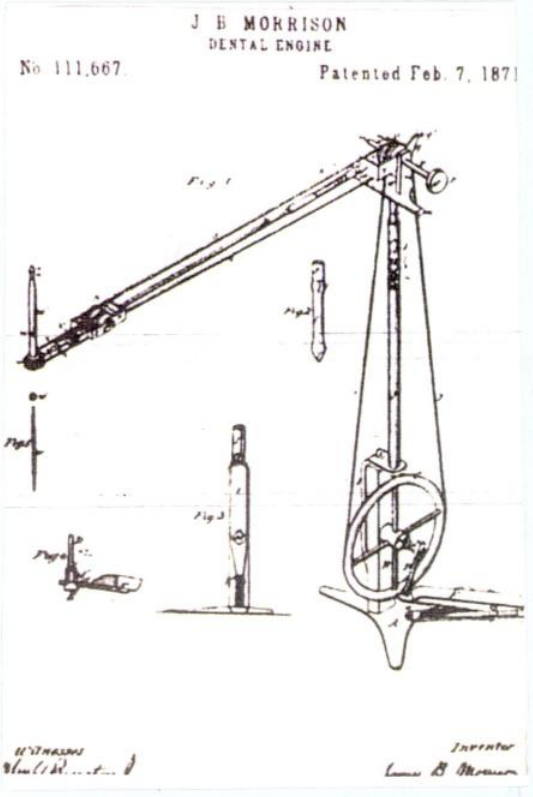

J. B. MORRISON
DENTAL ENGINE
No. 111,667. Patented Feb. 7, 1871

Figure 21

(From Ring, 1985, p.251).

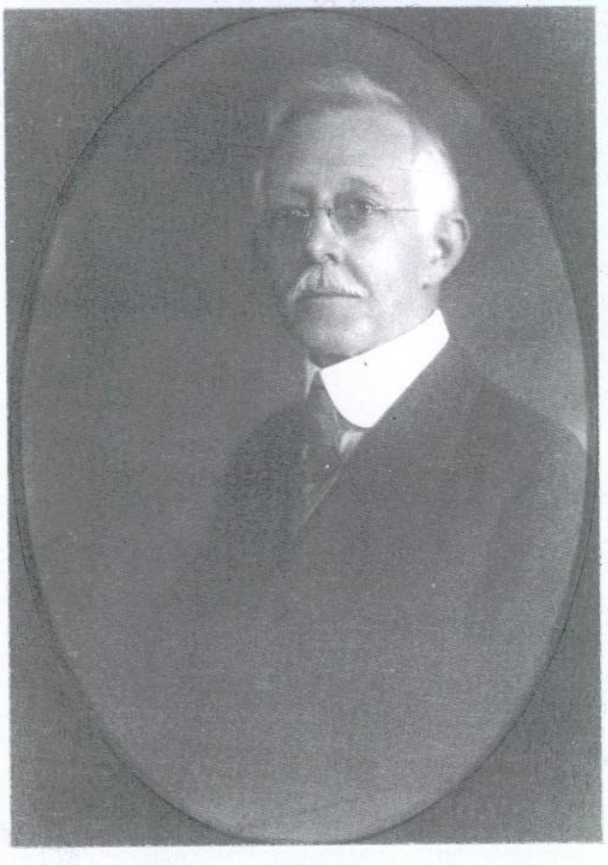


Figure 22
(From Ring, 1985, p.273).

In 1871, the first metal dental chair was manufactured by S.S. White Company. This was designed by James Beall Morrison who also invented the foot operated drill in 1871 (allegedly from an old spinning wheel that was driven by a foot treadle). The chair could be raised or lowered by turning a crank attached to a central screw (see figure 23). In 1877, the first pump type hydraulic chair- "Wilkerson Chair"- was produced. This had an added innovation, a compensating back rest which moved to maintain the same position relative to the patient's back.

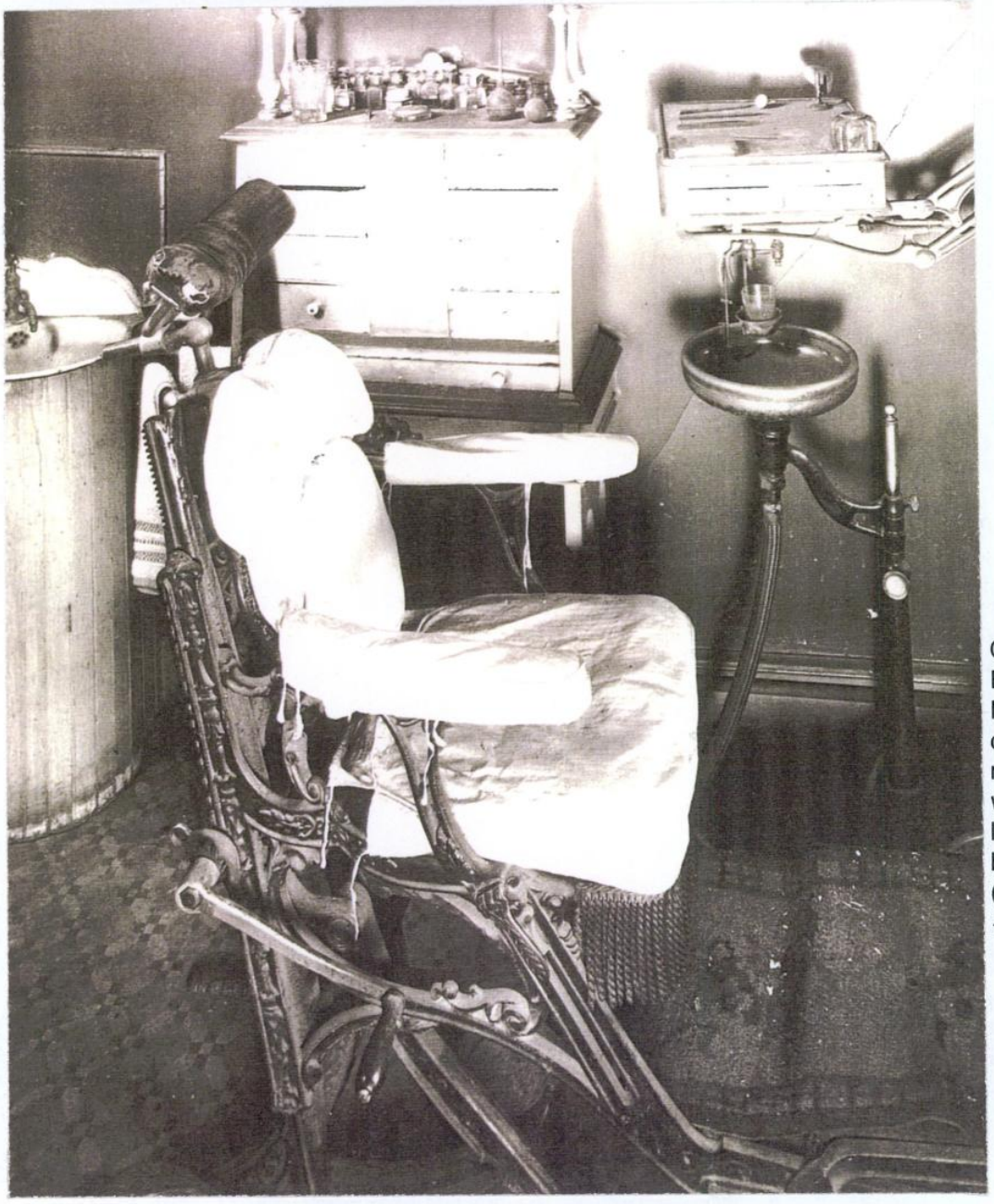


Figure 23

Circa 1900, Baltimore, Maryland dental office, with running cold water and gas lamp illumination but no electricity. (From Ring, 1985, p.261).

Towards A More Modern Dental Practice

Tremendous improvements were made in the quality of dental care with the introduction, in the early post-war-period, of the high speed turbine drill. For years, dentists had used rotary drills which worked at a top speed of 5,000 rev./ min. and discomfort was often felt because of vibration, pressure and heat that developed in their use. In 1957, the big breakthrough came with the introduction of the Borden Airotor by S.S. White Company, the first clinically successful air driven hand piece, which developed speeds of 300,000 r.p.m. and used no gears at all. Since then, hand piece design has only being slightly modified, with all new models utilising a tiny turbine directly driven by compressed air. A small but important headway was made in the 1970s, when fibre optic components built into the drill handpiece allowed light to be concentrated on the working area. So the enormous contribution made by S.S. White Company to the advancement of dentistry is obvious- especially in its formative years. S.S. White Company still dominates the market worldwide and has diversified into all branches of dental manufacturing.

Chapter

(4)

Streamlined Dental Units

- Interplay with Furniture Design.

Streamlining In Furniture Design

In the USA, the business recession of the late 1920s expanded into fully-fledged economic depression. Manufacturers turned to product re-design, at first as a tool to overcome competition in their own industries, but later with the aim of restoring the nation's economic wealth.

In 1932, Arens co-authored a book entitled Consumer Engineering: A New Technique for Prosperity. According to his interpretation of economic depression, the nations manufacturing techniques had become so efficient that production had over-run consumption. He put forward the idea of efficient engineering of consumption to bring it into balance with production. The industrial designer or consumer engineer, applied principles of behavioural psychology to make products so desirable that they should sell themselves. He considered that designers should aim not only to fit the product and the promotion to the existing market, but to create new needs and stimulate consumption by every possible means.

In response to this, people involved in advertising, such as Norman Bel Geddes and W.D. Teague, found themselves fulfilling

the role of industrial designer. They developed a style of streamlined industrial products. Examples include everything from trains to domestic appliances such as refrigerators which all benefitted from this new style. This new mode of clean-lined appliance design, which eliminated visual complexity and emphasised simplicity of operation prepared the way for public acceptance of streamlining as a style that promised to eliminate complexity and friction from society in general. More than anyone else, Geddes popularised streamlining as a design style by means of his book Horizons, which was first published in 1932 at the height of business infatuation with industrial design. (Noblet, 1993, p.186).

During this period, many changes took place in dentistry as well. Dental Surgery Assistants (DSA) became indispensable and led to the development of "four handed dentistry" in which dentist and DSA both seated, work as a smoothly functioning team in handling instruments and carrying out treatment (figure 24).

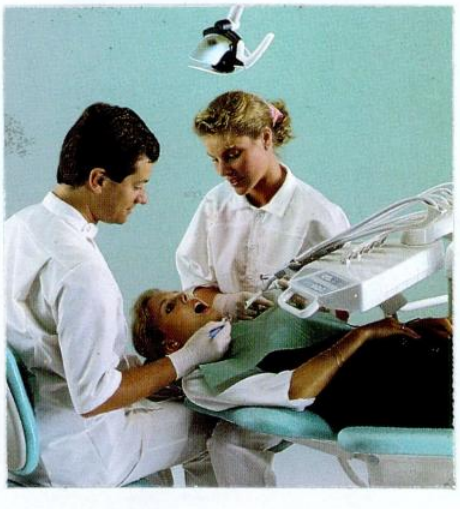
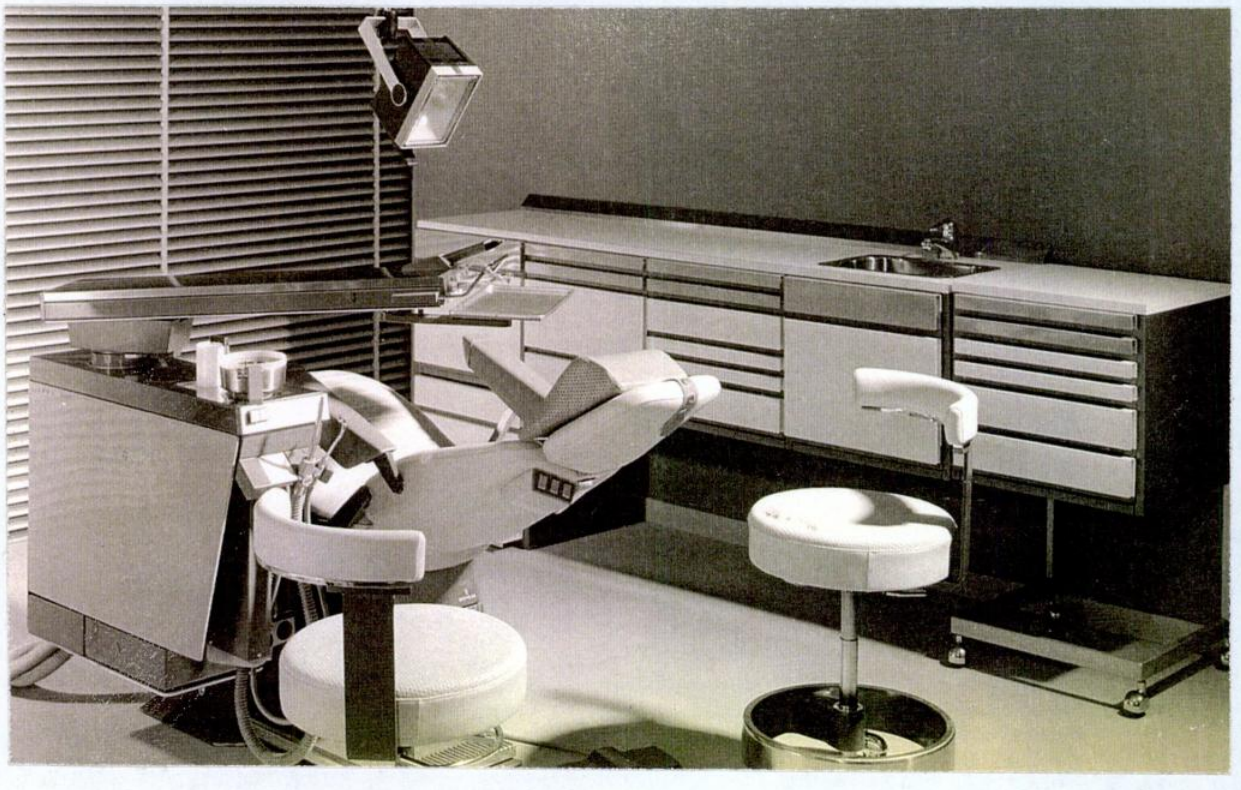


Figure 24
Four-handed dentistry.
(From Planmeca literature, 1996).

With new materials, technology and an emphasis on hygiene, streamlined surgeries became the norm, mirroring developments in domestic goods and furniture design (figures 25).

Figure 25
Streamlined office of the 1970s. (From Ring, 1985, p.309).



Streamlining Of The Dental Chair.- Interplay With Furniture Design.

One question remains to be answered fully, what caused the dental chair to evolve into the streamlined product that we see today?

- Were the sleek lines proposed to fulfil a sales objective?
- Did streamlining develop purely for functional reasons and to promote improved hygiene and cross-infection control?
- Was the goal, one of ergonomics, with patient and operator comfort in mind?

All of the above came into play at different stages as the dental profession itself learned and applied newer technologies and materials to their existing pool of knowledge. For example, many aspects of patient treatment have changed and it was only in the late 1940s and 1950s that dental surgeons adopted a predominantly seated position while working on patients. This promoted a necessity for completely different designs of dental chair from those which were already on the market. Accordingly the shape of the dental chair changed from the upright barber chair to the more familiar reclining models available today.

If one looks at domestic furniture from this period (1940s, 1950s & 1960s) there are many examples of chairs adopting the reclining position. This development largely came about due to the introduction of new materials and manufacturing processes. These materials were more malleable and thus could adopt more easily to the body shape. Upholstery was also developed to provide more comfort. For example- Osvaldo Borsani Chaise Lounge model number P40, 1954 (see figure 26).

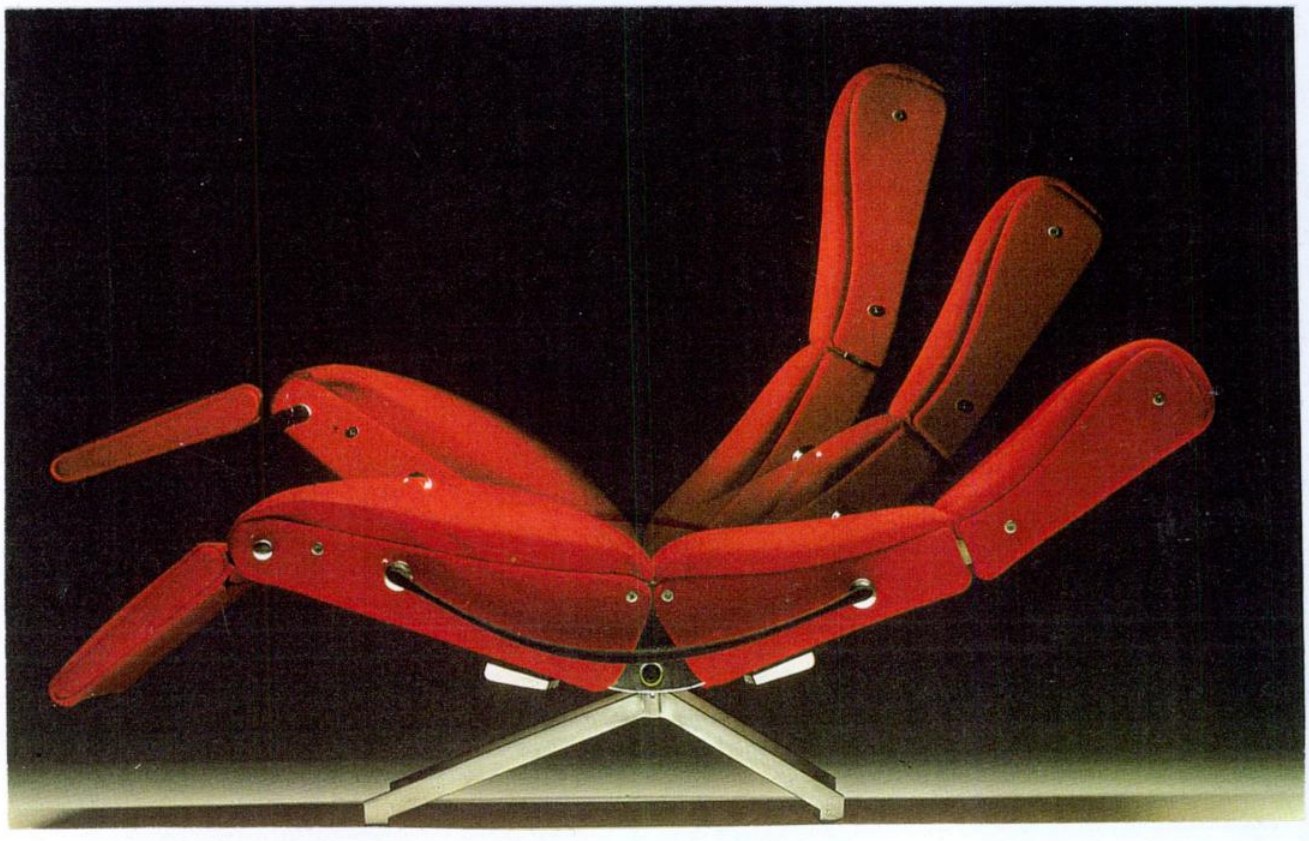


Figure 26 (From Fiell, 1991, p. 57).

Techo (1950s) described this chair as "a machine for sitting on

of the greatest sophistication". It has a retractable foot-rest and its elements can be adjusted to take up 468 positions. Compare this to the chaise lounge by Michael Thonet, late 1860s. They are similar in that they make the body adopt a lying position but new materials and technology transformed its overall look.

At a similar time, i.e. the 1950s and the 1960s, the Livingstone dental chair, pivoted on a fixed base, was produced. Its similarities lie in the moving parts and reclining position achieved.

Ahead of his time, Le Corbusier, in the late 1920s devoted much of his energy to ergonomics in chair design (even though the science technically did not exist during that period). It comes as no surprise that his chairs are still in use even today. The innovative movable seat section with adjustable neck rest affords a great degree of comfort to a wide range of users - a feature that has guaranteed the design's continuing appeal. Likewise, dental chairs provide wide user range, moveability and comfort. Simply at a glance one can notice many similarities between the modern dental chair design and that of Le Corbusier's (figure 27 & 28, over leaf).

Figure 27
Chaise Lounge c. 1928. (From Fiell, 1993, p.53).

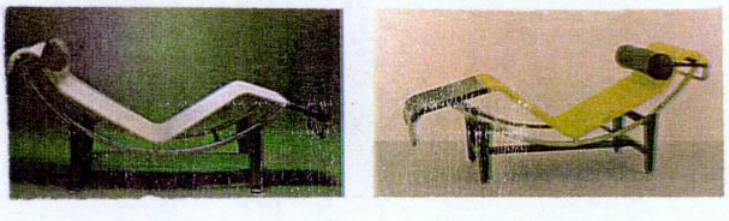
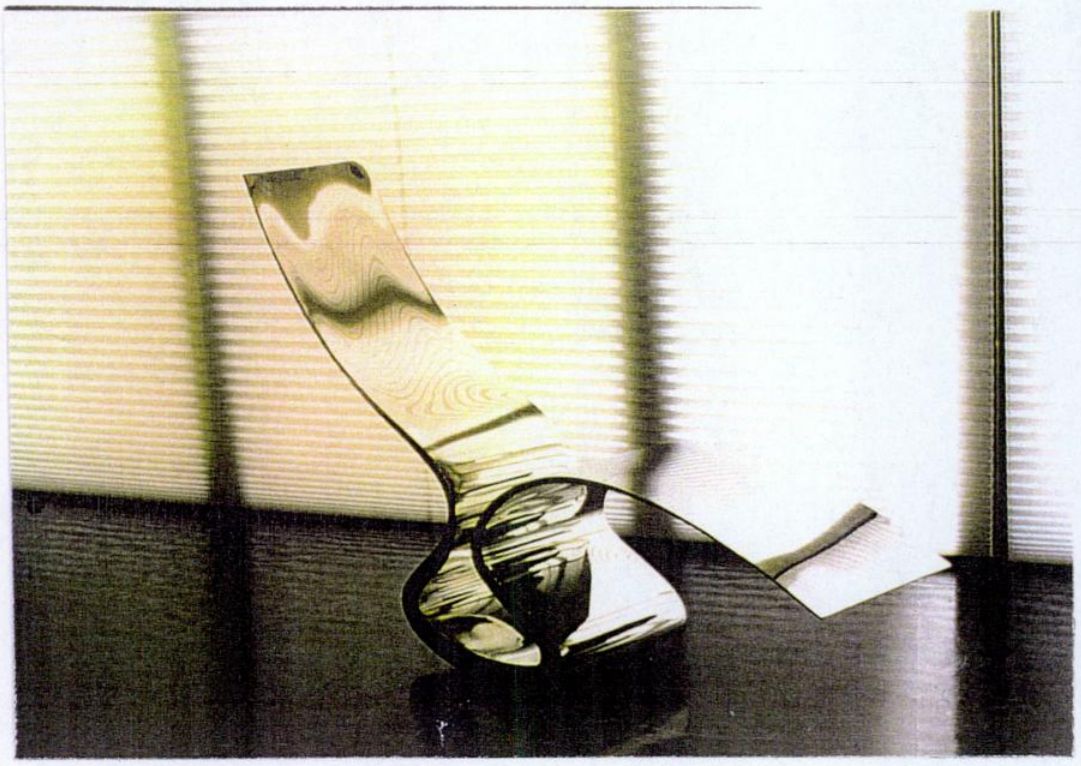


Figure 28
(From Fiell, 1993, p.53).

However, the definition of comfort is not susceptible to ergonomic measurement alone - it is rooted in conventions that have a visual as well as physical basis, an emotional as well as rational content. In other words, chairs that look comfortable, are generally perceived as being comfortable.

The development of the dental chair was spurred on by many of the previously mentioned domestic chairs (by adopting similar shapes and materials but changing them to meet the special requirements of the dental practice). Looking today at dental furnishings, one can still see a link between the shape of dental chairs and domestic chairs. Ron Arad's chairs (1996, Milano) are made from havel cold steel material a far cry from the latex used in dental chairs- but the shapes which the body can adopt are similar in both. (See figures 29 & 30, over leaf).



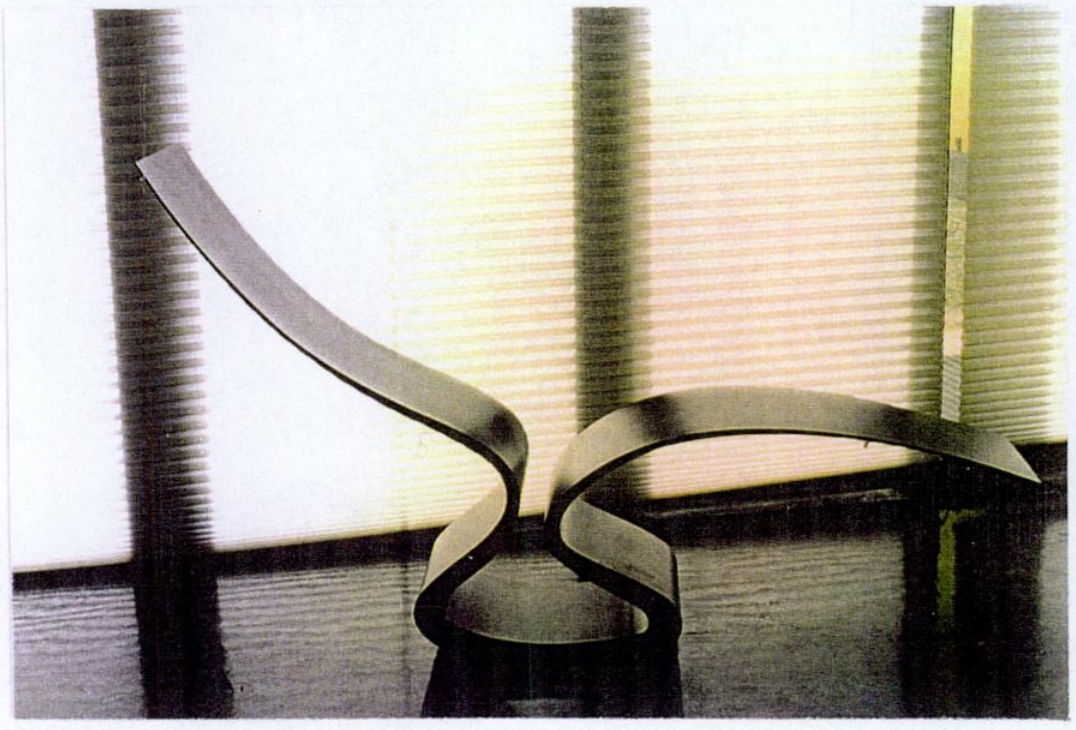
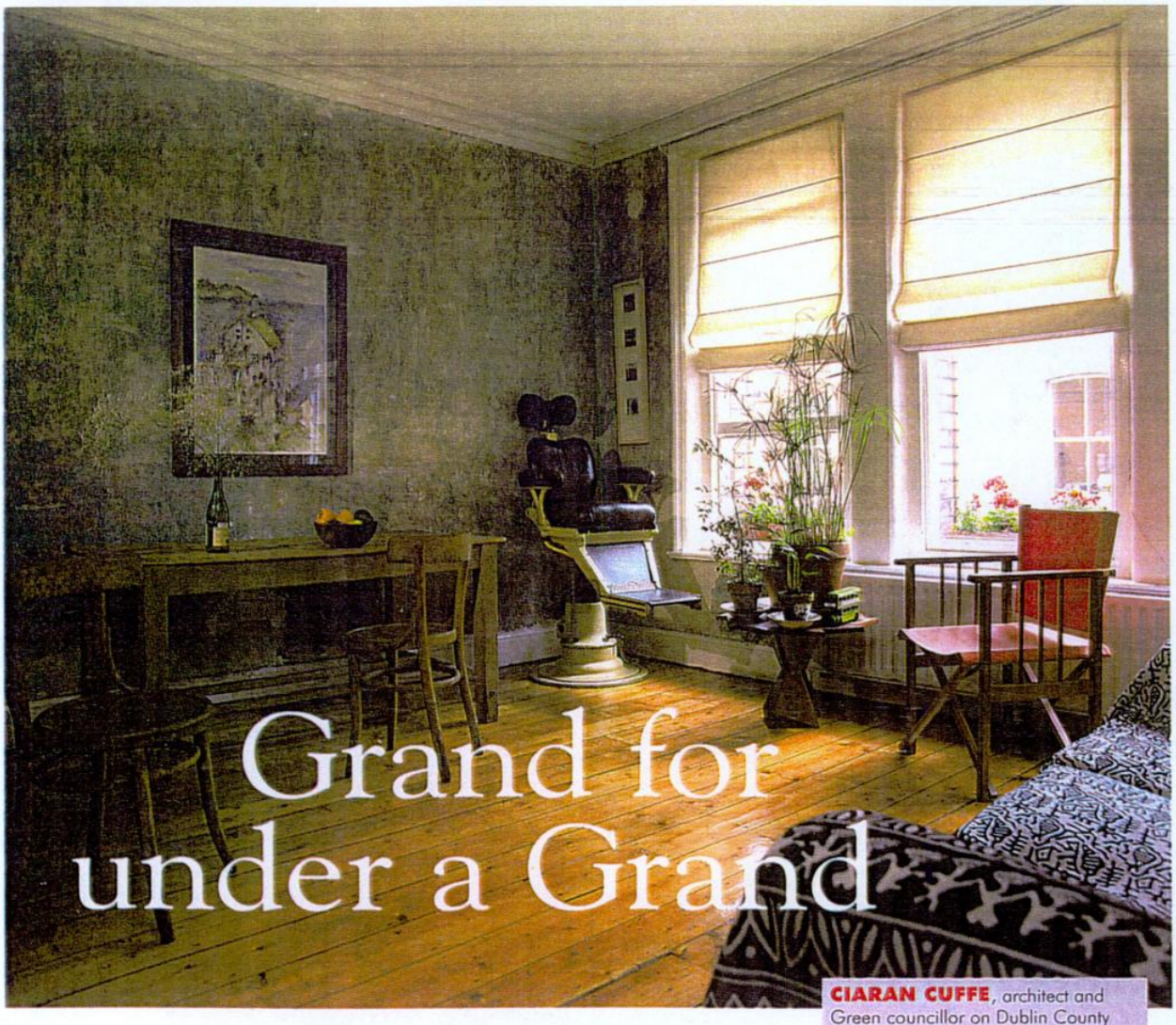


Figure 29 & 30
Ron Arad chairs. (Photographed in Milan, 1996).

Possibly, dental chair design influenced Ron Arad in finding a form. Today, the public view dental chairs as being comfortable. They certainly have been researched to achieve such comfort and this fact has not been lost on an ever more informed public. As such, Ron Arad could have used shape similarity to intimate comfort in his chair design. If so, this raises an interesting point, with regard to the interplay between domestic and dental furniture design. Things have come full circle- i.e. dental chairs using domestic furniture to demonstrate comfort to the patient (Remember: the first dental chair was an adaption of the Windsor Chair) and now the standardised shape of the dental chair- so familiar to the public- has been taken from the dental surgery to the living room. One simple example of this can be seen in a 1993 edition of Image Interior magazine where a dental chair has become part of the furniture in a Dublin home starting a new and exciting trend (figure 31, overleaf). The fact that it stimulated so much media attention is proof enough that people are fascinated with seeing dental chairs in the home environment as well as this being a testament to their comfort. Ron Arad could be deliberately developing this idea.



Grand for under a Grand

Tight budgets and bright ideas can produce the most imaginative interiors. FRANCES POWER calls on five DIYers who created amazing spaces for under a grand. Photographs by JOHN GEOGHEGAN.

HERE'S a home truth: style does not depend on the size of your wallet. If you can afford a tin of paint, you can afford to decorate in style. That's the good news. The hidden costs are hard work, broken fingernails and a relationship-threatening obsession.

First, bring each room back to its basics, strip wallpaper, roll back tacky carpets, confront what you've got in house. You may find your floorboards can be waxed or varnished and left *au naturel*. Or if you don't like the woody look, colourwash or stencil.

Splash out on paint, be brave – colour can shape or break a room. Haunt auctions. Sales staff will often put down a bid for you if you can't actually attend. Trawl through the markets, junk shops and skips for cast-offs. Check out territories moving up the social-scale – Portobello and the Liberties are good skiplands. Not only will you find cookers, fridges and other fittings, but serviceable chairs, desks and so on which can be given a facelift with polish and paint. Cultivate starving artist friends and feed them in exchange for paintings. Pick up prints in markets and stalls and frame them yourself.

Anything is possible with imagination and effort. According to one DIYer, the effort spent on hunting down and restoring a piece is doubly repaid by the house proud glow of achievement.

CIARAN CUFFE, architect and Green councillor on Dublin County Council

bricks	£50
sofa cover (Indian shop)	£50
director's chair (Ikea)	£30
table made of mahogany triangles and sofa (skip); dentist chair (removed with permission from derelict house); table (junk shop),	£40
chairs	£30 for both
calico blinds (by Gwen Lindsay)	£50 each
print (by Tracy Staunton)	
painting (by Pat McAllistair, both presents)	
GRAND TOTAL	£300

"The only real decision was to strip the room down to its basics – remove standard stipple wallpaper and ill-suited carpet. Once the walls revealed themselves, the floor was stripped and varnished, the windows cleaned of months of inner city grime, the room did not seem to need much. In fact, apart from the window boxes, most of the furnishings are leftovers from others or presents."

Figure 31
(From, Image Interior magazine, 1993).

Chapter

(5)

Contemporary Dental Surgery Layout.

- Dental chair design - Dublin Dental Hospital, Past to Present.

Dublin Dental Hospital Dental Chairs. (1895 - Present Day).

For the purposes of comparison, Dublin Dental Hospital offered a unique opportunity to photograph a wide selection of dental chairs and units dating from 1895, when it first opened its doors, to the present day. (It was originally a private hospital, Dr Owens' Hospital (figures 32 & 33, over leaf).

The Dublin Dental Hospital is a haven for many models of dental chair and it is possible to see the evolution of design in dentistry by examining the many fine examples of dental chairs encompassing many periods. The oldest chairs are currently in storage in Dr Stephen's Hospital, Dublin. These were wooden, non-upholstered, manually driven, upright chairs widely in use in Ireland up to the 1950s. A museum has been proposed to house them.

In an interview with Dr Barry Harrington, director of Dublin Dental Hospital, the author gained great insight into many of the old dental chairs. A particular museum-piece mentioned was a mid nineteenth century Murray dental stool, one of the most impractical of all dental inventions. This stool was attached to the wall by a spring which invariably sent the dentist flying whenever he/she stood up!

Figure 32
(Photograph of Dublin Dental Hospital / School 1895-1997).

Figure 33

Baltimore Dental School. The first dental college in the world, opened on November 3rd 1840, with five students. (From Ring, 1985, p. 215).

The oldest examples still found within the Dental Hospital are in use in the X-ray Department, where patients routinely sit for treatment (figure 34 & 35).

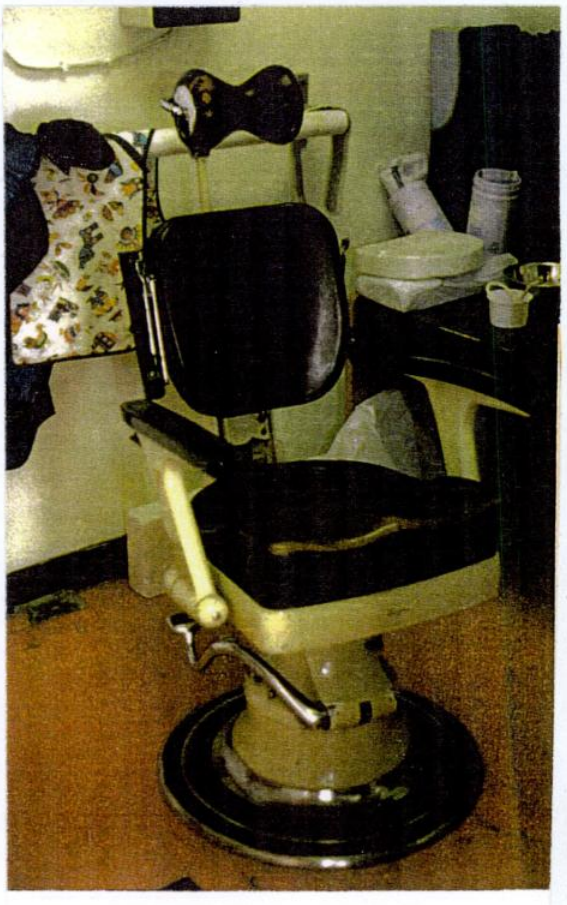
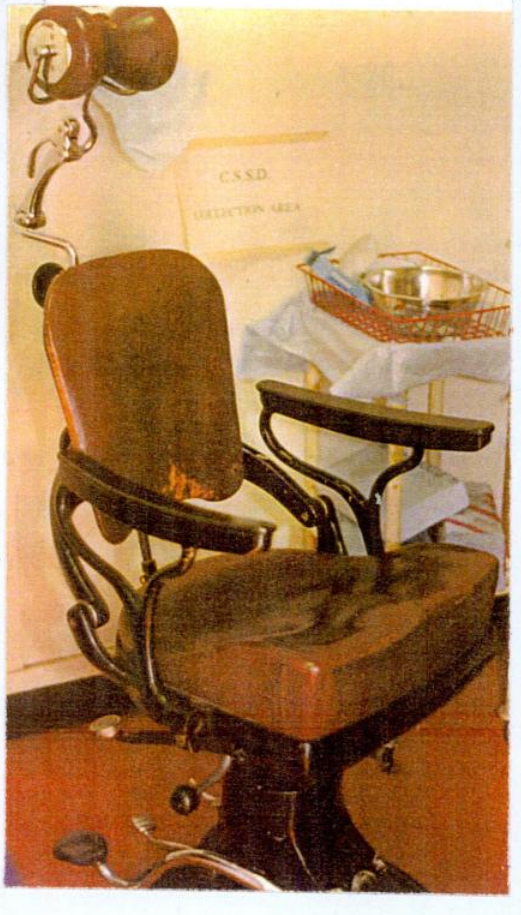


Figure 34
(Photographed in Dublin Dental Hospital, 1996.)

Figure 35
(Photographed in Dublin Dental Hospital, 1996.)



These Sterling chairs - manufactured in Britain - could be mistaken for barber chairs at first glance. Note the upright position, overall masculine look and swivel design features. (Interestingly, the 90 degree swivel has been carried through to present day designs. For example, the Proline 2002, by Planmeca, is designed with a 90 degree needle bearing swivel movement from left to right with firm locking. This swivel action is a valuable feature. It meets the requirements allowing better access, especially in rooms where space is limited). However, when one bears in mind that the dentist mainly stood while working up to the 1950s, it is not too surprising that these chairs resemble a barber chair (figure 36).

Figure 36

Note the standing position used by the dentist. The chair is similar to the sterling chairs photographed in the Dublin Dental Hospital -See figures 34 & 35. (From Ring 1985, p.298).

These chairs were very simple because dentistry as a profession was in its infancy and technology and materials were basic. These swivel chairs were functional - mechanically operated using a lever arm to adjust chair height and head rest. Note the head rest, which is shaped to accommodate the patient's neck. Looking more closely at figure 34, the black leather chair has a most interesting feature, in that, by simply adjusting a chrome lever, the back rest may be moved from a vertical to horizontal position thereby creating a high seat. Note the two small arm rests suitable for children. This is a novel design feature incorporated into an adult-sized chair to allow treatment of children at the dentist's working level. Unfortunately, this idea has been discarded and is not in use today.

As already mentioned, the materials used were basic leather and steel, seams and joins are widespread - hygiene and cross infection control not being kept a priority. Also note, there was no accompanying dental light. All in all, it is not difficult to imagine how well these U.K. designed Sterling chairs would have fitted into the period style of the old Dublin Dental Hospital.

With new knowledge and developments in dentistry, it became the norm for the professional to sit while working-with the patient lying down often in the so called Trendlebourg Position

i.e. feet at a higher level than the head to lessen the likelihood of faints etc. Accordingly, chairs needed to be adjusted from the sitting to the reclining position.

Livingstone Chairs were purchased next by the Dublin Dental Hospital- about twenty five years ago (figure 37).

(Photographed in Dublin Dental Hospital, 1996).

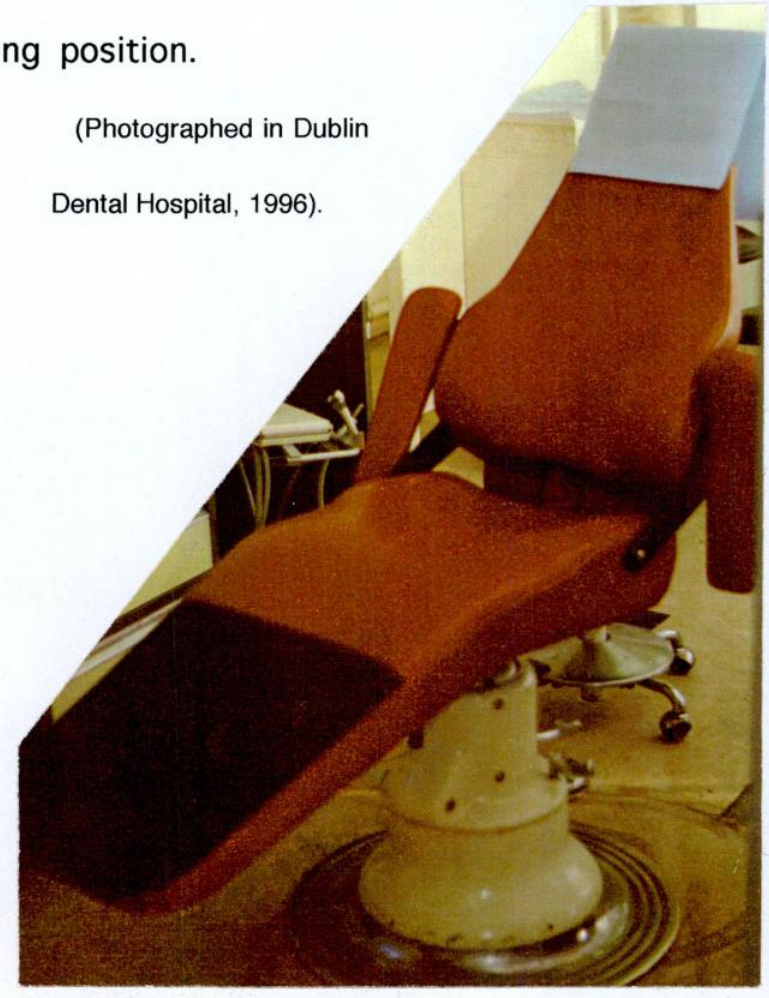


Figure 37
A Livingstone chair. These had fixed bases originally and were converted to up / down swivel chairs when the bases of old sterling chairs were added.

These chairs were pivoted on a fixed base. As yet materials were basic and the chairs were leather covered with seamed joints and operated by use of a mechanical lever arm. Later these chairs were upgraded by removing the fixed bases and fitting the base of the old sterling chair. Note that the purpose of the base is not only to support the chair but to house the hydraulic mechanisms enabling the chair to be raised and lowered.

The next major development mirrored that of domestic furniture design. New materials revolutionised seating upholstery and the concept of hygiene and streamlining led to new look electrically operated dental chairs. As a result Dublin Dental Hospital purchased the electric Kavo Chair (1978). The 1985 Siemens Chair in figure 38 & 39, features armrests integrated into the chair back and a flat headrest-making for a more organic shape and also decreasing the number of seams (thereby ensuring the chair is easier to clean). Note the finned organ type base and rubber covered foot control both conducive to gathering dust and bacteria. However, the foot control was a new feature being separate from the dental chair itself. It has since been adapted to promote better cross infection control.

Figure 38
(Photographed in Dublin Dental Hospital, 1996).

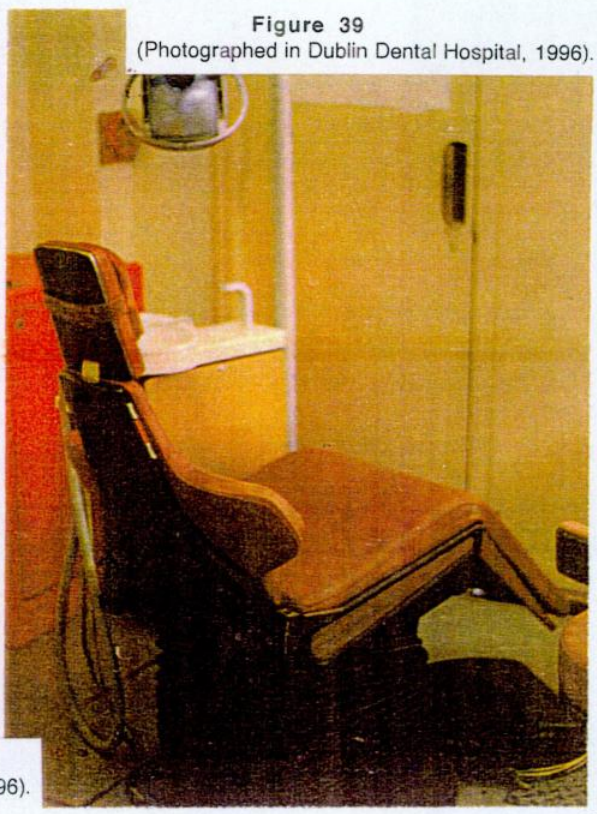


Figure 39
(Photographed in Dublin Dental Hospital, 1996).

The new Siemens unit of 1993 and 1994 featured a more rounded headrest and paid more attention to the dental light which is attached to the chair and not merely an accessory. It has an electronic touchpad control panel and fibre optic handpieces (figure 40).

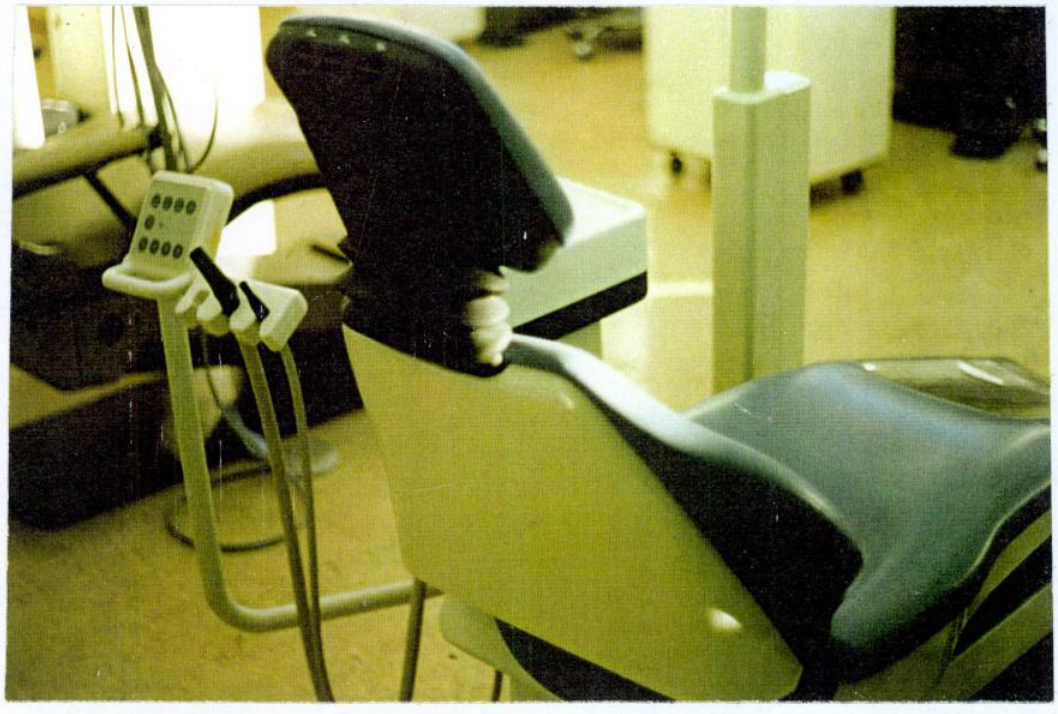


Figure 40
The first dental chair in the hospital to boast intraoral lights found in the hand-piece.
(Photographed in Dublin Dental Hospital, 1996).

The new Dublin Dental Hospital is expected to open in May 1997. Ninety new dental chairs are being imported from the Planmeca Company in Finland as part of the refurbishment. These Prostyle Compact dental chairs are worthy of a paper in themselves! (See figure 41 over leaf & Appendix A). However for the purpose of this case study, there will be a focus on the relevant design features in the following chapter .

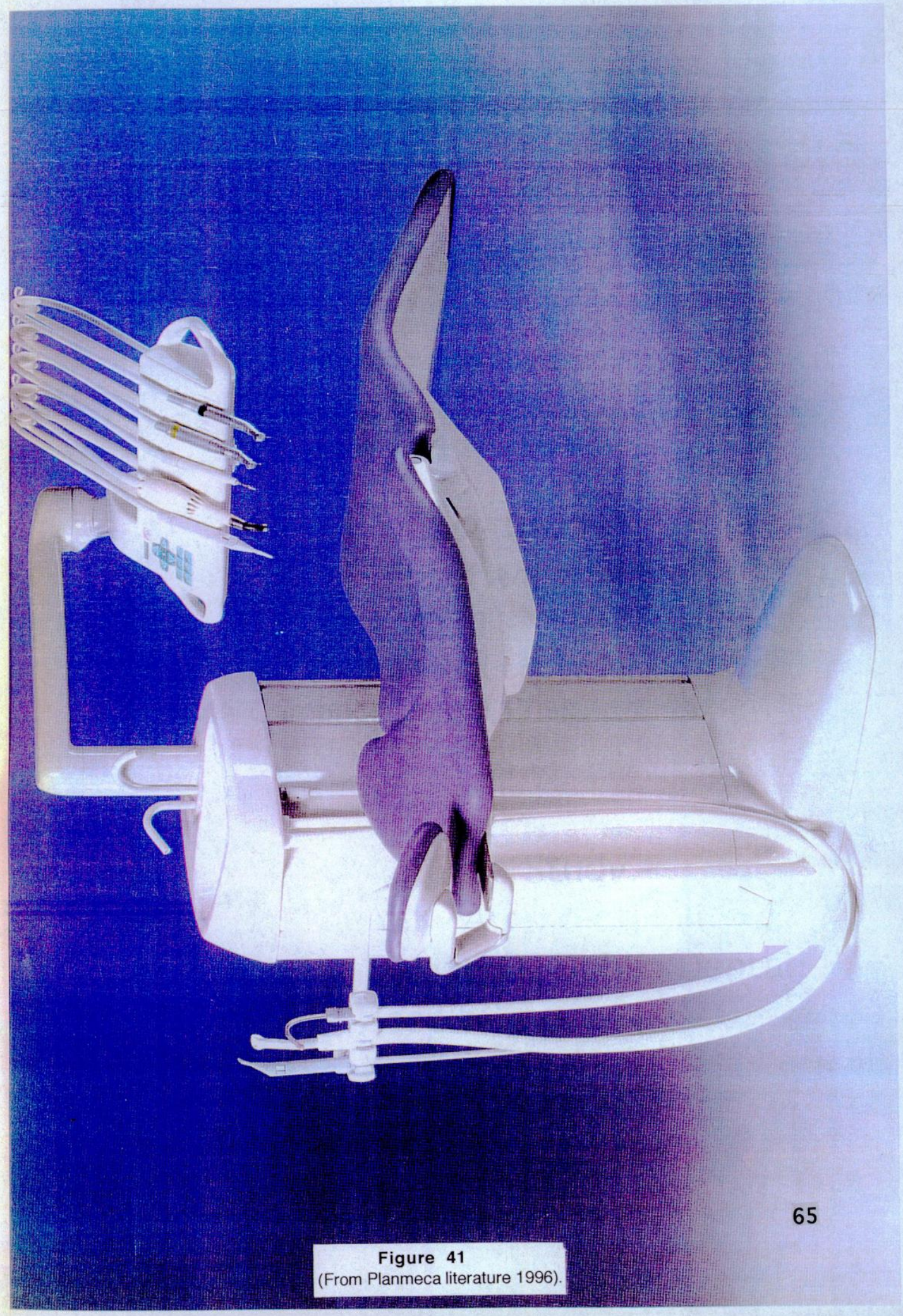


Figure 41
(From Planmeca literature 1996).

Chapter

(6)

(1)Case Study Planmeca Finland (1971 - 1997).

- Its Modern Dental Products Including The Prostyle Compact Dental Chair.

(2)Case Study - ABK Architect's Interior Design Of Dublin Dental Hospital

-Standardization Of Dental Surgeries.

(i) PLANMECA

Planmeca is one of the world's leading manufacturers of dental equipment. The company was founded in 1971 and,since then, has steadily built an international reputation for a complete range of dental equipment which includes units, chairs, stools, operating lights and panoramic x-rays.

All Planmeca products incorporate design and technical features that make them unique in their class. For example, the internationally renowned PM 2002 CC line of dental equipment has been a major breakthrough in dental technology.

The PM 2002 CC chair, introduced in 1983, was the world's first micro-processor controlled dental chair. This was followed in 1986 by the world's first microprocessor controlled panoramic x-ray, the PM 2002 CC. Planmeca's pursuit of perfection then led to the introduction, in 1989, of the PM 2002 EC series of dental units and a panoramic x-ray. The continuing product development led to the new PM 2002 Proline Series of dental equipment, launched in 1992. PM 2002 Proline range of dental units and chairs combine the latest technological innovations

with a modern ergonomic design (figure 42). The PM 2002 Proline CC x-ray has several new features that have never been available before in maxillofacial radiology.

Figure 42

(From Planmeca literature 1996).

A recent development within Planmeca has been the design and manufacture of the Prostyle range which incorporates Prostyle Compact dental unit, Proscan multimodal tomographic system, Prostyle Intra, digitized intraoral and panoramic x-rays system and Intra-cam intraoral camera. The Prostyle range has been internationally well received and further underlines Planmeca's determination to continue to lead the way in product design and development into the 21st century.

The company enjoys an international reputation for high standards of product quality, consumer satisfaction and outstanding technological innovation. Planmeca presently manufacturers and markets the following product ranges:
multimodal tomographic imaging systems, panoramic x-rays,

digitized imaging systems, intraoral x-rays, dental units, patient chairs, stools, operating lights and intraoral cameras.

Planmeca's world-wide success can be attributed to market as well as product development. Dental manufacturing is very competitive and each product must be aggressively promoted to achieve sales. See Appendix B (p.116-p.125) for some of the promotional literature circulated by Planmeca, Finland.

Planmeca's Modern Dental Chair Design.

(As seen in Dublin Dental Hospital)

The Planmeca's Prostyle Compact is a dental unit designed for modern dental care (figure 41 & 43). It is ergonomically adapted for the working procedures and positions used in both two and four-handed dentistry.

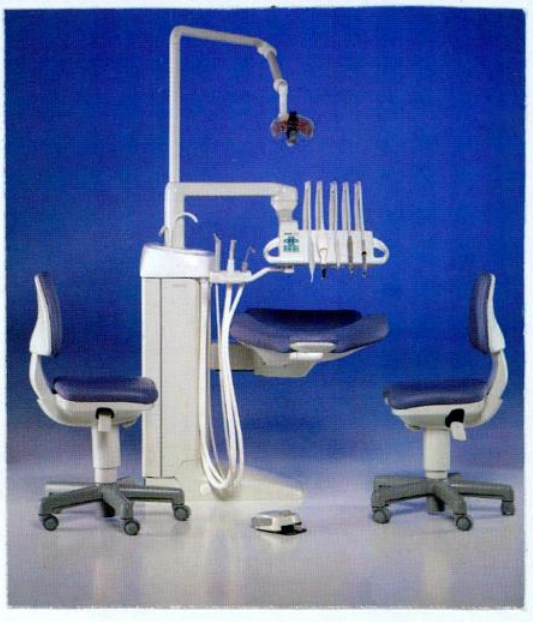


Figure 43

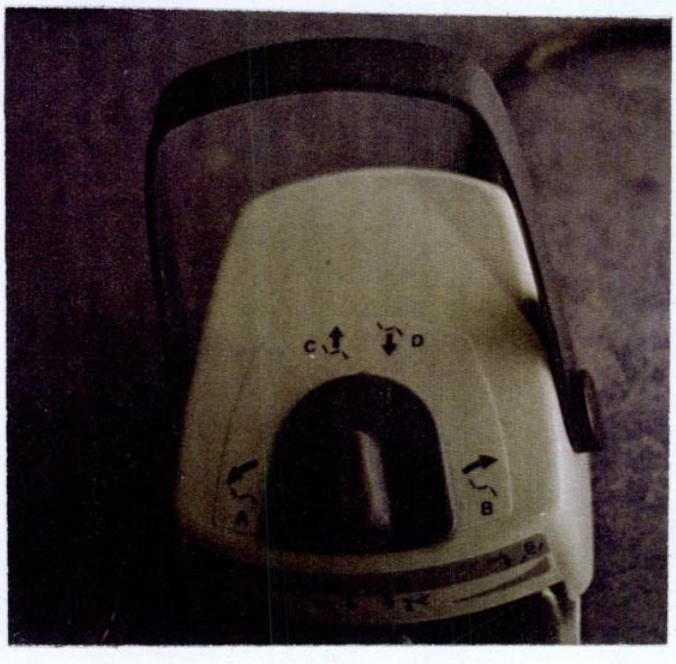
(From Planmeca literature 1996).

Excellent ergonomics of the unit has been achieved through its simplified construction. The unit is technically advanced, with

all practice- related controls. Prostyle Compact's exceptional design consists of unit spittoon/frame, chair, delivery arm and light. All functions are combined together into a smoothly performing integrated unit. The floor area required for the Prostyle Compact unit is minimal (see figure 44 over leaf). Only the foot control breaks the uniform floor surface (figure 45).

Figure 45
(Photographed in Dublin Dental Hospital, 1996).

Note the development in the number of controls between the Siemens's design (1980s)and the new Planmeca Prostyle (1996). The amount of hand-control functions is being kept to a minimum for cross infection control reasons.



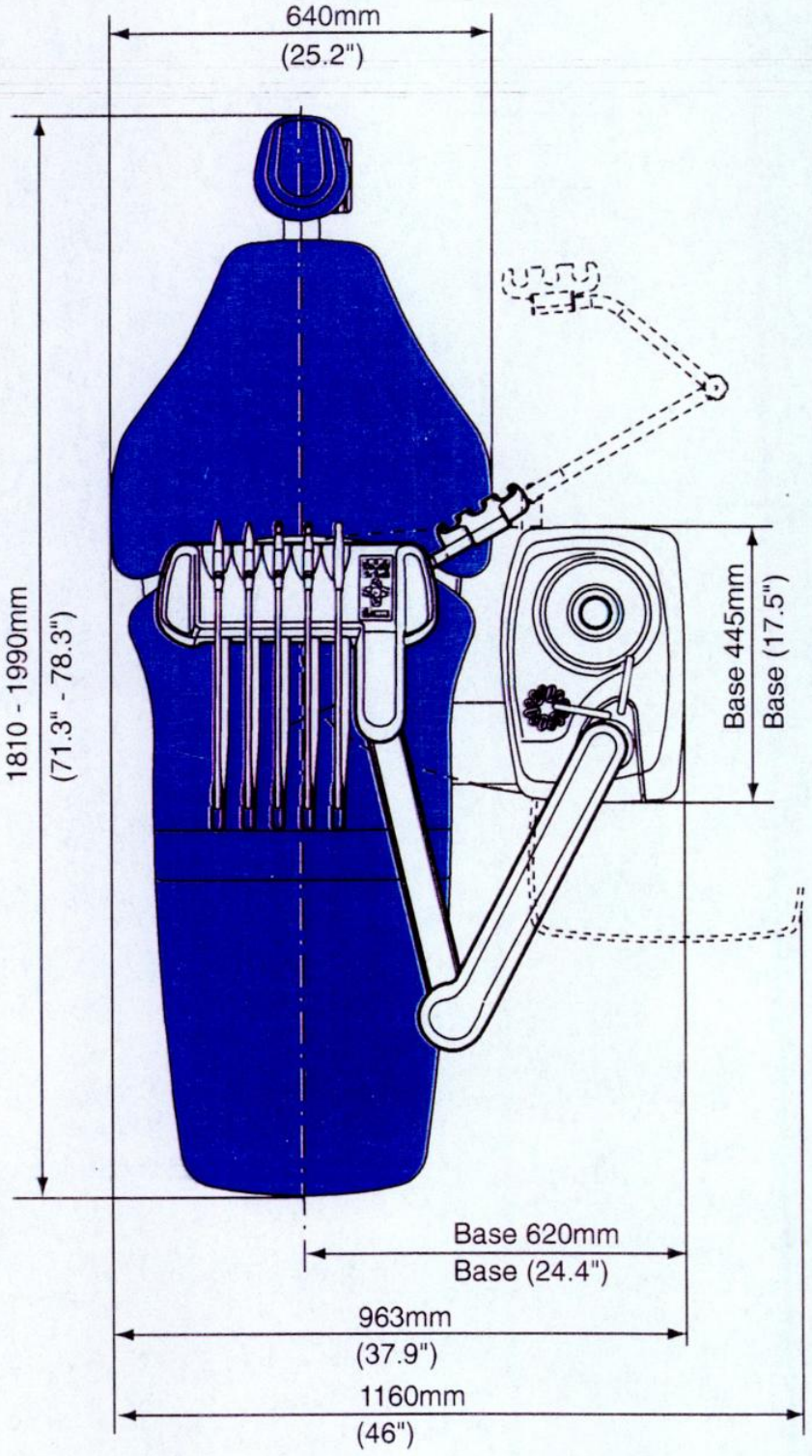


Figure 44
(From Planmeca literature 1996).

Working stools are not obstructed by a chair base. This revolutionary cantilever design of dental chair allows the operators more freedom of movement, (see figures 41 & 43). The chair has all the elements which provide comfort including compensation of backrest movement and a firm, yet comfortable support. Surface hygiene is excellent due to smooth, seamless, crevice-free, rounded surfaces. The delivery-arm has a new design featuring a joint construction without bellows covers. Attached to the delivery-arm and integrated with the dental chair is the porcelain spittoon bowl. This has a body of cast aluminium, galvanised steel and is finished with baked epoxy powder coating- making it fully corrosion resistant. Notice from figure 46 (over leaf) how this spittoon is similar in shape to the Wendell Castle chair (1969-1970) in figure 46 (a) over leaf. This chair is considered a sculpture in plastic. Does this make the new Prostyle spittoon an art form? Can we look forward to more interesting shapes appearing in the dental surgeries of the future?

As already mentioned, Dublin Dental Hospital is refurbishing the new building with ninety Prostyle Compact chairs made by Planmeca in Finland - a lucrative deal worth millions of pounds. Dublin Dental Hospital maintenance mechanical/electrical engineers must undergo at least two weeks of intensive training

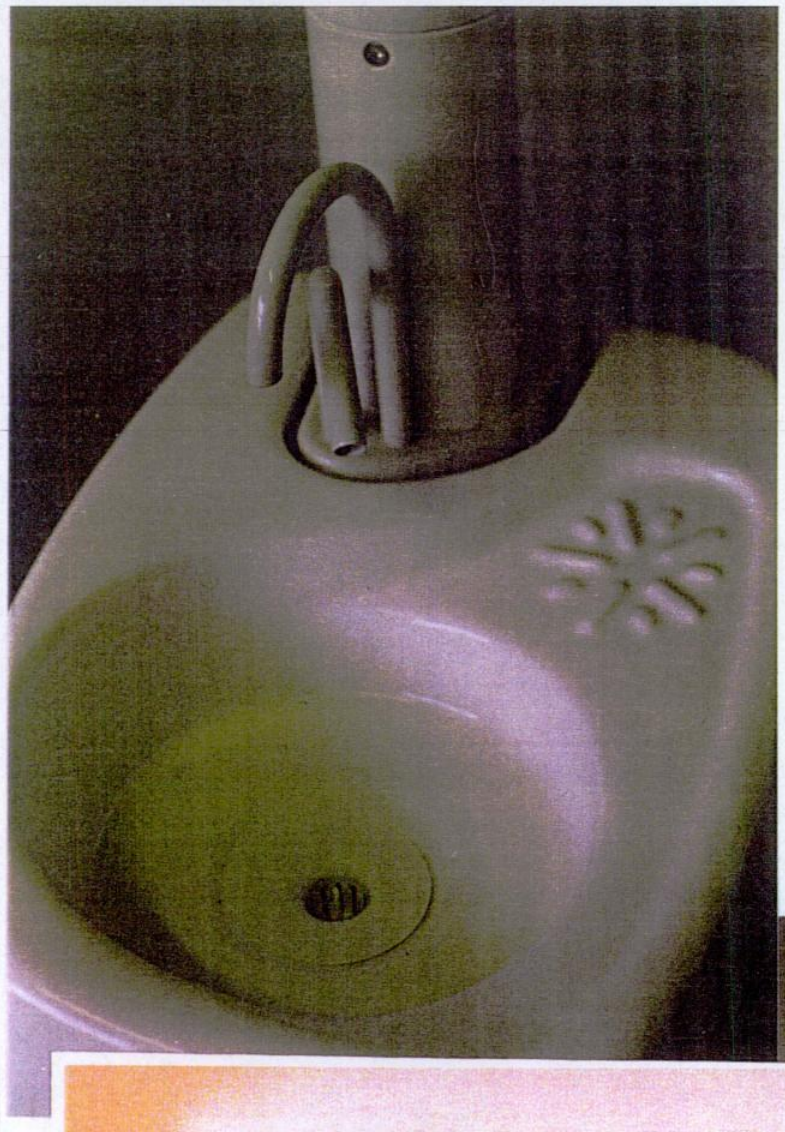


Figure 46
(Photographed in Dublin Dental Hospital, 1996).

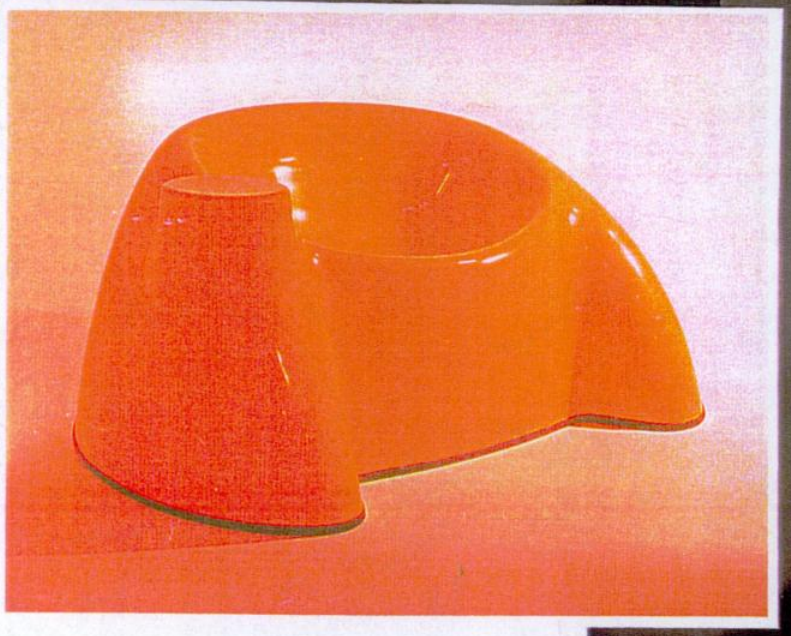
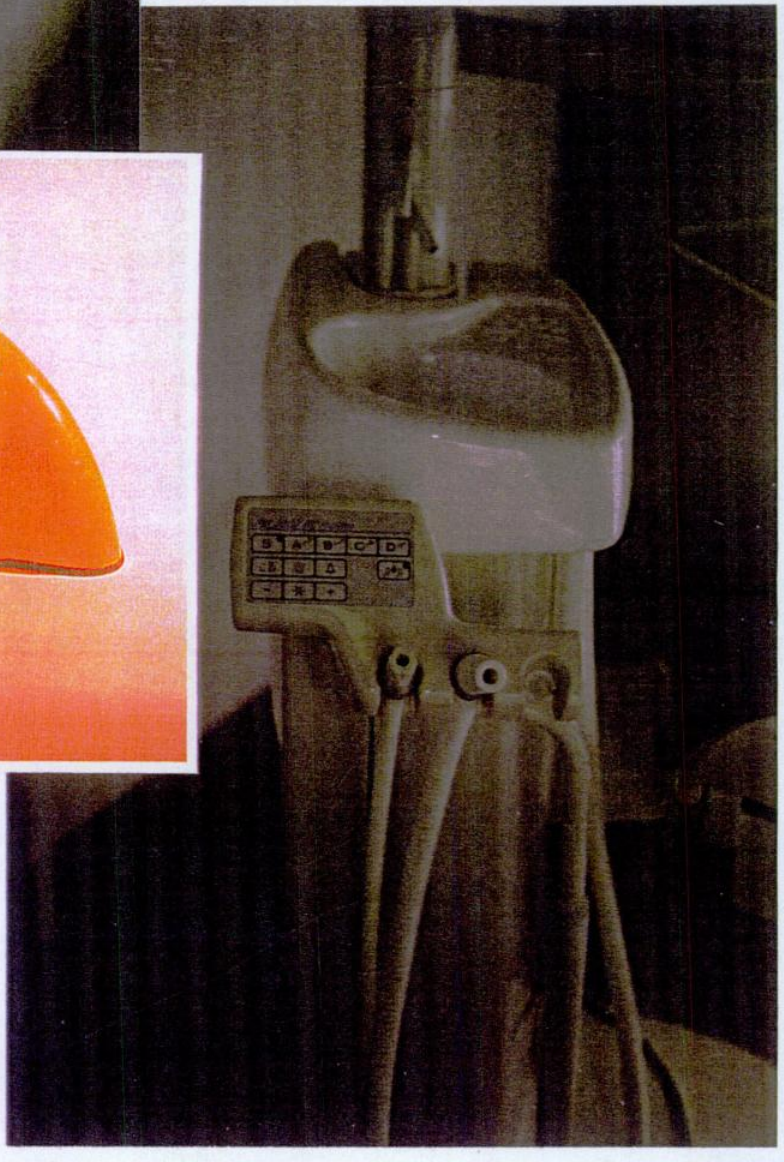


Figure 46 (a)
Wendel Castle Chair
(From Fiell, 1991 p.104).



in Finland to thoroughly familiarise themselves with the workings of this most modern dental chair. See Appendix A (p.96-p.116) for complete details of the Prostyle Compact dental chair - the most up to date of its kind available on the world wide market today.

With the current emphasis on ergonomic design, including the streamlining of dental unit and surgery as a whole, a firm of London architects has been employed to design the units surrounding the new Prostyle Compact dental chair. The idea of a company specifically designing the dental unit surround for a large number of surgeries is a concept that has not been explored to date in this country. Unlike medical surgeries, there is a lack of standardisation in dental surgery design. Compare figure 47 a Dublin dental surgery with figure 48 (over leaf), another practice in Sligo. Note the differences.

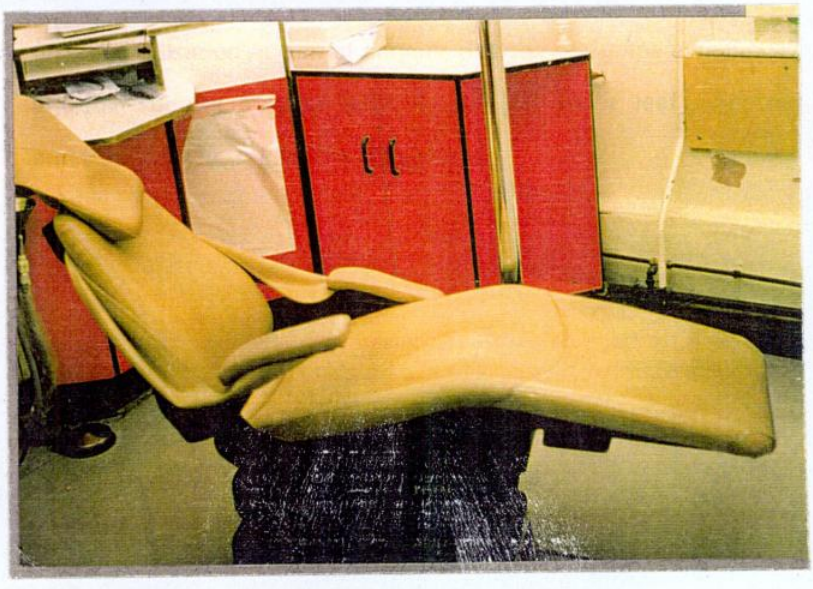


Figure 47
(Photograph of a private surgery in Dublin, 1996).

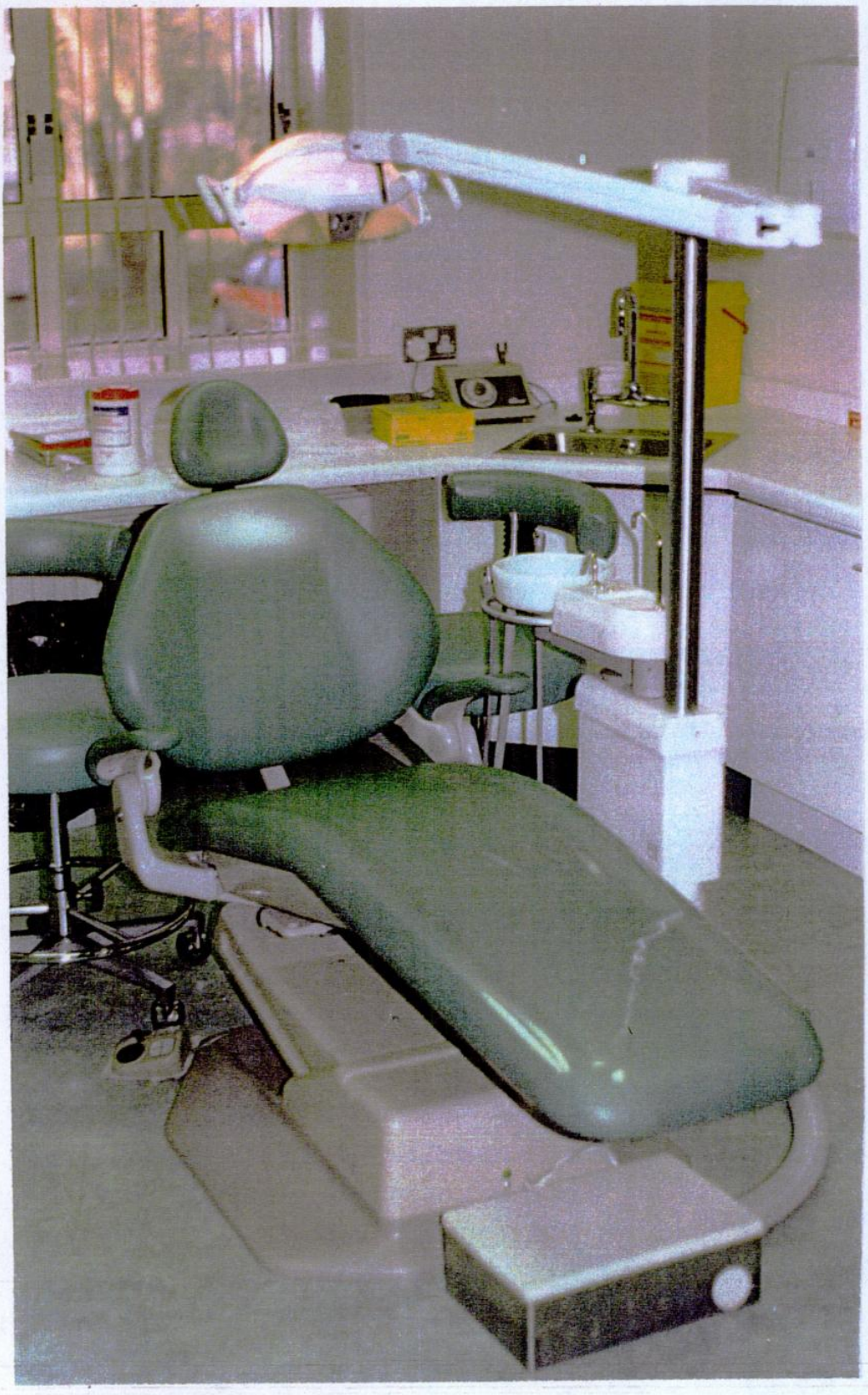


Figure 48
(Photograph of a private surgery in Sligo, 1996).

Not only this, but there is also a lag behind standard office furniture design. So we must refer back to the origins of purpose-built office furniture to see where the future lies for standardisation of dental surgeries.

Systems Furniture

Purpose-built office furniture was first produced on an industrial scale with Frank Lloyd Wright's designs for the Larkin Building in Buffalo, New York State in 1904. It wasn't until 1968, however, when the open-plan office was invented by Systems Furniture in the wake of the Herman Miller Company launch, that the sharp divergence between office and domestic chairs began.

Systems furniture involves not just the end of the traditional desk and cupboard, but the invention of a complete new language to describe their replacements. A work-station which would make better use of the limited office space was the system which replaced the desks and cupboards. Systems furniture depends on skilled designs for its planning and expert installers for its assembly. Therefore, systems furniture does not allow for one to buy a single desk and put it together independently.

Viewing the dental chair as a desk or "work station" for the dentist, it is possible to see how a similar systems furniture method of equipping a surgery could be applied. Unintentionally the chair or "work station" has been developed in the systems furniture method with the addition of unit facilities such as spittoons, lights, trays etc. However, the surrounding shelving and storage systems have not been modularised. In recent years, norms for height, hygiene and space requirements have emerged but the surgery seems to fall short in realising the same quality of standardisation and modularisation commonplace in a 1990's office.

Even the office chair, which can be compared to the dentist's stool, figure 49 (i.e. sitting at a workstation for eight hours a day) has an interesting history attached to its development.

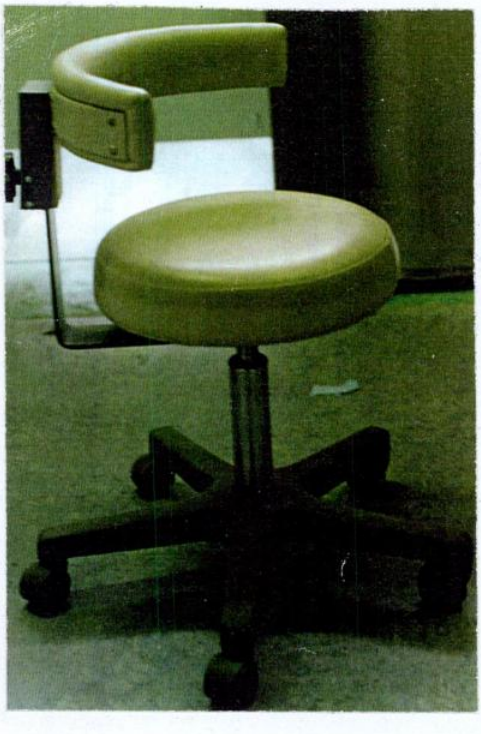


Figure 49
Note the seamless upholstery.
(Photographed in Dublin Dental Hospital, 1996).

Demands for comfort prompted improved chair design with competition increasing between various companies. Modern factories produce office chairs with robot welders and automatic point spray facilities making the production of these chairs a highly specialised area. Notably Planmeca have all these facilities and use them in the manufacture of dental chairs and dentists' stools.

When Emilio Ambasz and Giancarlo Piretti first produced the Vertebra office chair by Castelli in 1978, it proved to be a huge seller (figure 50) and afterwards, every reputable office chair manufacturer had to develop a similar system.

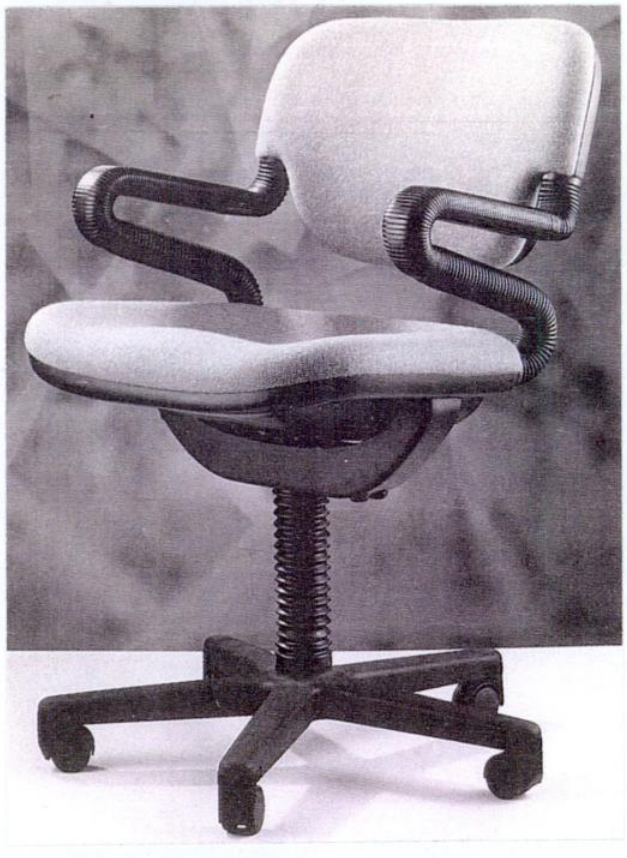


Figure 50
Vertebra Office Chair
(From ICA, 1988 p.40).

Likewise we can see in dental chair design how one company has led in design with a major improvement, thereby achieving large sales and spurring rivals to produce the equivalent to keep in touch. Planmeca Prostyle, for example, was chosen by Dublin Dental Hospital because of its superior design features - most notably the shaft - driven system which requires no oil and allows the chair to be side mounted eliminating the need for a base and thus improving accessibility for the dental surgeon. Siemens and other dental manufacturing companies must now strive to produce innovative design features.

Dental surgery design has come a long way from the carpeted interiors of the nineteenth century to today's streamlined 'work stations', but there remains much room for further development. By comparing office design and surgery design, it is peculiar to see how diverse business operations are conducted in modularised offices world-wide, whereas in dental surgeries, (with similar procedures performed regardless of country), there remains a lack of standardisation and no uniform system of work station has been designed.

In the Dublin Dental Hospital A.B.K. Architects are designing and building the surgery work surfaces and storage units, but even these have not been mass produced in a modular way as with office furniture. See Appendix C (p.126- a to j) for plans of the new Dublin Dental Hospital by ABK architects.

(ii) Report on Ahrends, Burton and Koralek Architects and their interior design approach to the new Dublin Dental Hospital.

The new Dublin Dental Hospital is being constructed by McNamara Building Contractors and must be completed by the end of April 1997 (figure 51, below).

Figure 51
(Photographed outside Dublin Dental Hospital, 1997).

In May 1997, eighty Planmeca Prostyle Compact chairs will be installed on two levels (with forty chairs on each floor). The interior design contract was awarded to Ahrends, Burton and Koralek Architects, London, who opened a Dublin office as a direct result of this large undertaking.

The brief delivered by Dublin Dental Hospital personnel was to design the eighty dental cubicles housing a dental unit and clinical workshops, while incorporating services and fittings. Fixings for the dental unit were to be designed in accordance with the main contractors' proposed structure and method of support for the dental cubicles.

A.B.K.'s approach began with research involving worldwide travel to investigate various dental hospital layouts and design. Then, following surveys and regular discussions with Dublin Dental Hospital staff, an interior design was drawn up, and, from this, the initial model 'mock-up' was built (figure 52).

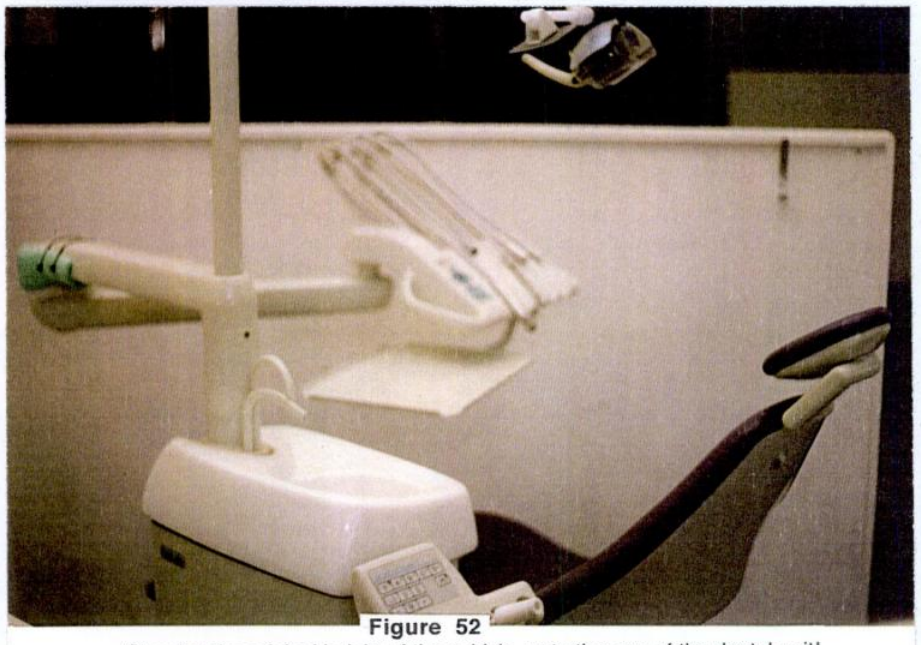


Figure 52
Showing the original height of the cubicle, note the arm of the dental unit!

One Planmeca Prostyle Compact chair was positioned in this partitioned space and 'dummy' cupboards and work tops installed, so that hospital staff could test the prototype layout. As a result of rigorous testing, some adjustments were made to the initial design - most notably to the height of the backboard. This had to be lowered to accommodate the arm of the dental chair which tended to hit the backboard when fully extended. The partitions are being built in 15 millimetre M.D.F. sheets coated with a protective, fire-resistant layer. This material was chosen because the Dublin Dental Hospital budget prohibited the use of more suitable, but also more expensive alternatives.

However, the concrete ceilings have proven to be a material choice of much worth. Apart from the obvious support function, they allow excess heat to be taken in during the day and given out at night - thereby conserving energy. This heat exchange is facilitated by the presence of eight exposed areas in the tiled celling (see Appendix C, p.126 (c)).

Layout

To maximise the floor space available, the cubicles on levels one and two will be positioned around fourteen hollow steel columns

which have a dual role - acting as both service channels and as support for the cubicles/dental units. Services such as wiring etc. were brought up from the first to the second floor in hollow steel pipes (placed through the concrete floors) and then directed to corridors for easy access.

Each cubicle will therefore be arranged in groups of either two or four - the latter being in the centre, while the paired cubicles are situated around the perimeter of both levels (see Appendix C, p.126 (a) & (b)). The dental chairs themselves will be placed so that access to the cubicle is from the right hand side, with the base (feet - end) of the Prostyle Compact fitting into the corner of each cubicle (see Appendix C, (a) & (b)).

The clinical work top/storage units are fabricated in 15mm compact laminate (white laminate, black core) and include the following features: radiograph viewer, chart holder, mask and gloves storage, domestic plug point, computer data point and dental chair cut-out switch. (See perspective view in Appendix C, p.126 (j)).

Conclusions

Overall, the design of the new Dublin Dental Hospital clinical units will be the most sophisticated worldwide to date. For the first time, the needs of the dentist were fully considered and accommodated. However, due to the limited space available and financial constraints, the ultimate ideal design was restricted. In the real world, is optimum design ever achieved? It is important to note that not one industrial designer was consulted by Dublin Dental Hospital. As Architect Director, Paul de Freine conceded, this would have been beneficial! With regard to modular dental cubicle systems being employed in the future, he was initially sceptical because of the great variation in the size and layout of dental surgeries. After discussion, he was cautiously optimistic - "a new idea to be explored!"

Chapter

(7)

Conclusions and Possible Future Trends - Learning From The Past.

General Conclusions

Having researched the development of the dental chair over the years, it is obvious how dental chairs have lagged behind furniture design, almost always borrowing from their discoveries rather than the other way around. (The only notable exception being that of dental chairs recently coming into the living-room as a trendy item of furniture).

Planmeca's Prostyle Compact dental chair design is a fine example of what has normally occurred to date- namely dental chair design following domestic office furniture design. With reference to figure 41, notice how the chair is supported from the side leaving space free underneath the chair. This is a new concept in dental chair design-being motivated to provide leg space for the dentist, as well as incorporating a shaft system to raise the chair (as opposed to the older hydraulic models which often leaked oil). In this case, there are marked similarities with the cantilever design of the 1920s domestic-furniture in that both systems discard the need for conventional underneath supports. The cantilever steel chair (figure 53) is regarded as one of the most potent symbols of modern furniture. It was pioneered by the Dutch architect Mart Stam with the chair S33 of 1926. For the first time in the history of furniture, through the

cantilever principle and resistant tubular steel, a stable chair could be constructed on only a single linear frame with two vertical elements - thereby dispensing with the conventional four legged chair.

Figure 53
(From Fiell, 1993, p50.).

This discovery changed the way designers approached furniture design. Now their minds could run wild applying the new idea and many did so very well, such as Mies Van der Rohe who became a master at designing cantilever chairs (figure 54 overleaf).

Ludwig Mies Van der Rohe:
Chaise Lounge, *model No. 241,* 1931.

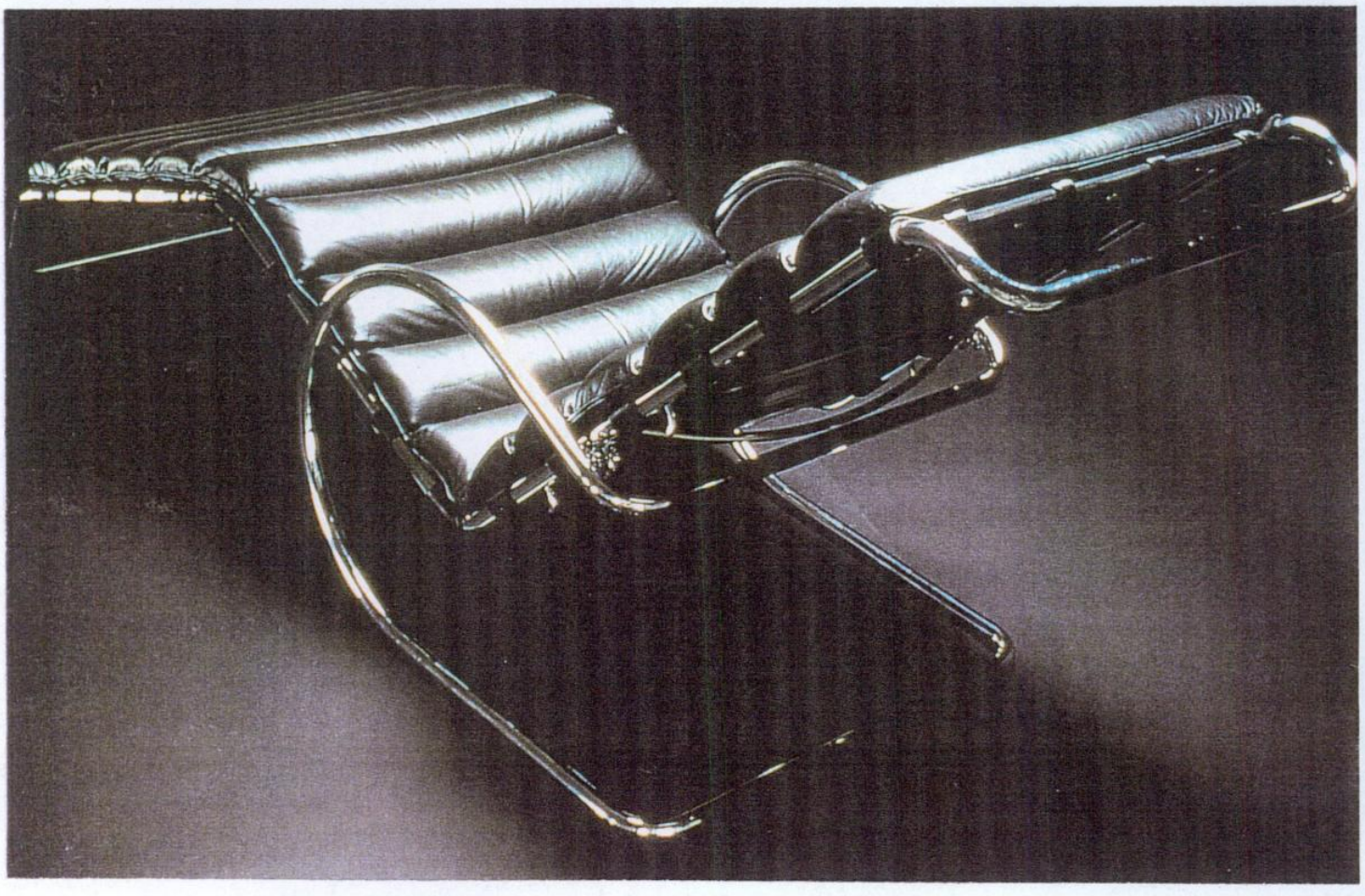


Figure 54
(From Fiell, 1993, p.10).

It was another seventy years before dentistry adopted this design. The Prostyle Compact answers a need for a functionally improved drive mechanism as well as providing a new innovative design in dental chairs.

In addition Bel Geddes (1932) wrote of the importance of well planned lighting and light intensity control in domestic settings. Again it took over sixty years before this concept was adopted by dental manufacturers- i.e. Planmeca Company with its 'Delight' dental light promoted for its high quality illumination and adjustable light intensity (Appendix A, p.103-p.105). There is obviously a huge discrepancy between the development of domestic furniture and that of dental chairs through the years, which can be attributed to a dearth of designer involvement in dental manufacturing. New materials and assembly methods were, and are, of course, available to both industries. This becomes even more apparent when we look at the Planmeca Prostyle Compact dental chair. 15% of the work force involved in its production are industrial designers and researchers. Unfortunately, the importance of industrial design has yet to be recognised by many companies in this country, even though it is over sixty five years since companies in the USA first employed industrial designers.

Possible Future Trends- Learning From The Past.

During the 1980s, firms in the USA realised that, through the decoration of their public and office spaces, they could create a corporate identity. Likewise, dental surgeries should adopt this concept. For this to be a viable option, all aspects of design in dentistry need to be explored further.

> Designing a chair is a demanding technical problem. But beyond that, it is also an act that can aspire to poetics. It calls for the resolution of ergonomic requirements to cater for the basic need of comfort, with aesthetic and formal concerns. To design a chair is to do more than to consider the form and manufacture of the chair itself. It must also involve a consideration of how it will be used and occupied. (ICA, 1988, p.5).

This applies most especially within the dental profession. Currently the stool used by the dental surgeon does not provide adequate support and is not distinctive enough if compared to, for example, an executive's chair. It is, therefore, both functionally and aesthetically inept and there remains great scope for improvements in its design.

Any change in design of the dental chair unit will, of course, be determined by the types of new materials and variety of technological methods available. As we approach the turn of the century, design has become a critical issue with global

indications. Designers increasingly find themselves working with industries which previously did not employ them, example: dental industry. This extra activity by designers in industry makes them even more responsible for the good or bad effects of industry. Choice of materials is vital. In the 1960s, the environmentally unsound anti-design ethic of expendability was often expressed in plastic- (a fundamentally non-disposable material). The rational use of plastics in the furniture industry however, may yet prove ecologically justifiable should the necessary incentives be provided for systems of effective recycling. Therefore, mistakes made in the past may be resolved by solutions only available in the future. The chair in figure 55 (overleaf) was featured in the Milano Furniture Fair which the author attended in 1996. It was marketed as the world's lightest chair at 980g, made of carbon fibre and varnished in black. Will we ever see the day when dental chairs have developed so much? Perhaps the answer lies in the development of new materials.

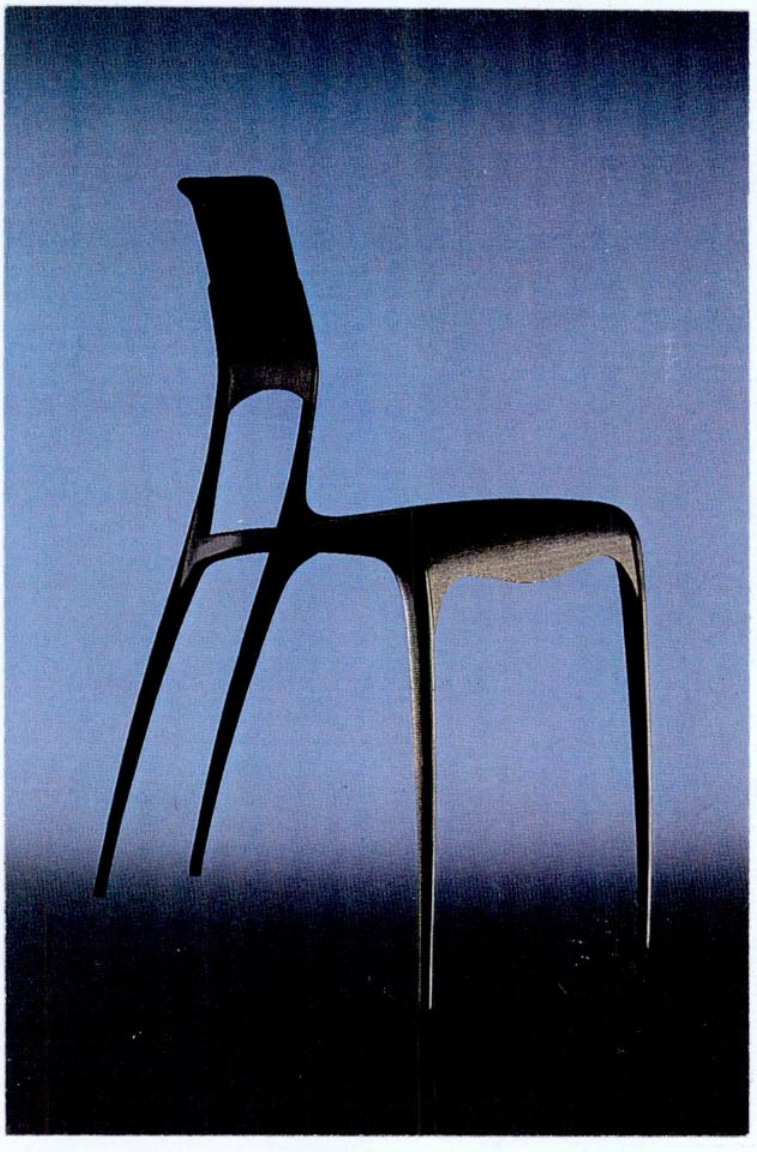


Figure 55
(Photographed by the author, 1996)

With regard to new technology, several alternatives to traditional methods of dentistry are being developed. For example, to replace the dental drill, dental lasers such as the Dentek LD15 are under trial (figure 56). Likewise Cad-Cam engineering is being applied for production of more precise ceramic restorations providing a possible alternative to amalgam and gold fillings.

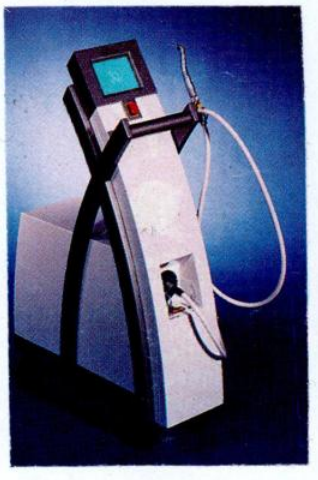


Figure 56
(From Dental Probe magazine, 1996).

The handpieces can be used to perform a wide range of applications including root canal treatment, caries prevention and soft tissue surgery. Used in conjunction with a proprietary dye, the system can also remove dental caries.

As we approach the 21st Century, it is believed by some that we lie in a similar position to that of the late 18th Century i.e. on the edge of another revolution which will change the way we conduct our lives. This revolution is centred on Nanotechnology and may spring a new type of professional, just as the Industrial Revolution promoted the rise of industrial designers.

Nanotechnology, or molecular technology, centres on the manipulation of industrial atoms and molecules with control and precision. Moore's Law, a law of miniaturisation, states that:

> Every 18 months transistors will halve in size and computers will double in power, (Drexler, 1990, p.76).

This is a valid deduction if one looks at technological development from the 1940s to the present day. Therefore, if this trend continues, by the year 2020 we will have entered the era of molecular manufacturing.

Charles Eames interpreted design as "a plan for arranging elements in such a way as to best accomplish a particular purpose" (Fiell, 1993, p.7). This is a classical definition of design and is necessarily rational. The rationalist design principles promoted by the Modern Movement represent the basis from which twentieth century design has evolved.

Following on from this, the proposed Nanoutopia Age will revolutionise our world, including that of design in dentistry. Materials will be produced at low cost, with no waste, designed especially to suit their use.

Designers will be able, at long last, to create their own dream materials capable even of moulding to individual body shape. This will change dental chairs as we know them today. They may resemble a 'blob chair' into which one sits and the material of the chair will determine the most suitable position of the occupant.

In the 1930s, moon-walking seemed like science fiction to the general public although those who were in the know could see it as a possibility. Far-fetched as our ideas first appear, we must remember that things are obvious when looking back but not when peering forward. Perhaps dental design would be more advanced today if industrial designers had been involved at an earlier stage. The way forward points to the development of modular systems of dental furniture on a standardised, mass-produced scale. Then, dental surgery design should soon overtake office and domestic furniture design- leading the way into the 21st Century.

...Appendix A

-Planmeca's Technical Data on The Prostyle Compact Dental Chair, (1996).

PLANMECA

PROSTYLE COMPACT

Prostyle Compact Patient chair

Chair Integrated to Unit

- Designed for dental care of both adults and children.
- Wide, stable support for back and arms.
- Side-lifting and thin backrest provides exceptional access for operator and assistant.
- Compensation movement of backrest provides ideal comfort for the patient.
- Double articulating prosthetic headrest allows optimum patient positioning, with hygienic design.
- Anatomical seat angulation.
- Integrated elbow support.
- Chair can be driven to the horizontal position.
- Variable pre-programmed working positions with memory, 4 positions and spittoon position for multiple users.
- Membrane covered keyboard with tactile positive feedback switching (1 unit control panel).
- Foot control operation integrates automatic and manual functions, foot control is equipped with solid state switching to eliminate microswitches and providing max. reliability.
- Powered by two low-noise electric motors, one for the seat and the other for the backrest.
- Lifting capacity 210 kg (463 lbs).
- Seamless hygienic upholstery without stitching, easy removal.
- Dimensions: seat length 112 cm ($44^{1}/_{10}$''), seat width 55 cm ($21^{1}/_{2}$''), Seat height min 350 mm ($13^{3}/_{4}$''), max 810 mm (32''). Backrest height 57 cm ($22^{1}/_{2}$''), backrest width 62 cm ($24^{2}/_{5}$'')
- Headrest slide range 130 mm (5'')
- Powder paint finish is scratch and chip resistant and not affected by surface disinfectants.
- Solid cast aluminium construction and painted inner surfaces guarantee a sturdy, corrosion free design, stainless steel screws.
- Standard frame colour RAL 9002 grey white.

Safety features

- Backrest is free to move upwards so that the operator's knees cannot be trapped when the chair is lowered.
- Electronic control overload protection.
- Chair movement can be stopped in an emergency by any chair control key or foot control.
- Dual safety switching for the chair base.
- Legrest free movement upwards if obstructed.
- Chair movement disabled if instruments are operated.
- Chair movement disabled if service door/cover open.

Chair

The Prostyle chair is integrated into the unit and it has a side-mounted lifting mechanism. Chair movements are stable and quiet. Patient comfort was given high priority in the design of the chair.

Comfort:

- Wide stable support for back
- Integrated elbow support
- Compensation movement of the backrest
- Fixed anatomical seat angulation
- Long leg support, 112 cm ($44^{1}/_{10}$") seat length (heels are not hanging outside the chair)
- Seat form allows easy entry and exit

Control:

The chair is controlled from the foot control switch (integrated with unit control), or from the unit keyboard. Manual and automatic movements are integrated in the switch, but separated with an activation delay. The advantage: a reduced number of switches but a simple and logical operation.

Memory covers 4 + 1 positions, all user programmable: Entry position, 3 working positions and spittoon position (last position). "S" will turn off the light, fill the glass, drive the chair up and when the position is reached, start rinsing. Reactivation of the switch will start rinsing again and the chair will be driven to the last used position.

The operation light dims always by 10% during chair movement. The light can be programmed to turn on or off with the memorized positions.

Spittoon position can be activated hands free from the foot control when instruments are inactive.

Safety:

Safety cannot be compromised in modern health equipment. Therefore every detail in the chair was scrutinized during engineering. It includes the solid cast metal frame construction and many other safety features:

- Lifting capacity up to 210 kg (460 lbs)
- Absence of sharp joints
- Backrest is free to move upwards, operator's knees cannot be trapped
- Legrest is free to move upwards if obstructed
- Dual safety switching for the chair base (stops and lifts)
- All chair movements stop by activating any chair control or foot control lever
- Electronic control overload protection
- Movement prohibited if an instrument is active or when spittoon door is open
- In downward movements of the chair, the seat motor will start with an automatic delay after a rising back rest to clear the knees (automatic feature, no need to program)

Ergonomics

The ergonomics concept of the unit is designed for both solo 2-handed dentistry and 4-handed work.

In 2-handed work the instruments can be placed in direct proximity of the working area. Instrument arms are lifted with very light but at the same time precise actions. The arms are stable, they do not wobble, but they are flexible even sideways to reduce the tension when the instrument is tilted.

The tray is positioned on the right side and the suction arm on the left side. Both are placed at a distance and height which is convenient for a solo user. The suction holder can be tilted upwards. This allows the dentist to make a natural hand grip of the suction handpiece and provides support to the hose. The load which weighs down the operator´s left arm during suction is minimized, and returning the hose to its holder is truly effortless.

The legroom is exceptionally spacious with elimination of the traditional cantilever base of the chair. There is no chair base the stools could hit. With no base, the chair descends into a very low position – a feature preferred by dentists who work from 11 o´clock and wish to keep the chair in a very low position.

For ergonomic operations of 4-handed dentistry, where the backrest is kept horizontal and chair base relatively high the chair can be lifted higher than most other chairs due to the construction of the lifting mechanism.

Op-delivery arm

The OP-delivery arm of Prostyle Compact unit has a new effortless adjustment mechanism and more hygienic design.

The construction of the instrument arm provides stable spring supported movements. Bearings are high grade needle-bearings, with capability for tension adjustment. Being fastened to the floor mounted unit frame, the arm is stable, shake- and drift-free giving the operator assured and relaxed control.

The gas spring adjustment is a simple procedure. Depending on how much weight is carried on the instrument console, the adjustment can be changed to correspond to different weight levels simply by snapping an adjustment lever to different tension levels.

The arm does dot follow the chair movements which adds stability to the arm and the instrument controle when the chair is moving.

The arm is constructed of cast aluminium and has no seams. The absence of seams makes it easier to clean than most competitives constructions. There are no plastic or ribbed rubber joint covers.

Rotating points and joint mechanisms have no extra play and are equipped with needle bearings. This results in precise and smooth functions. All bearing points can be friction adjusted.

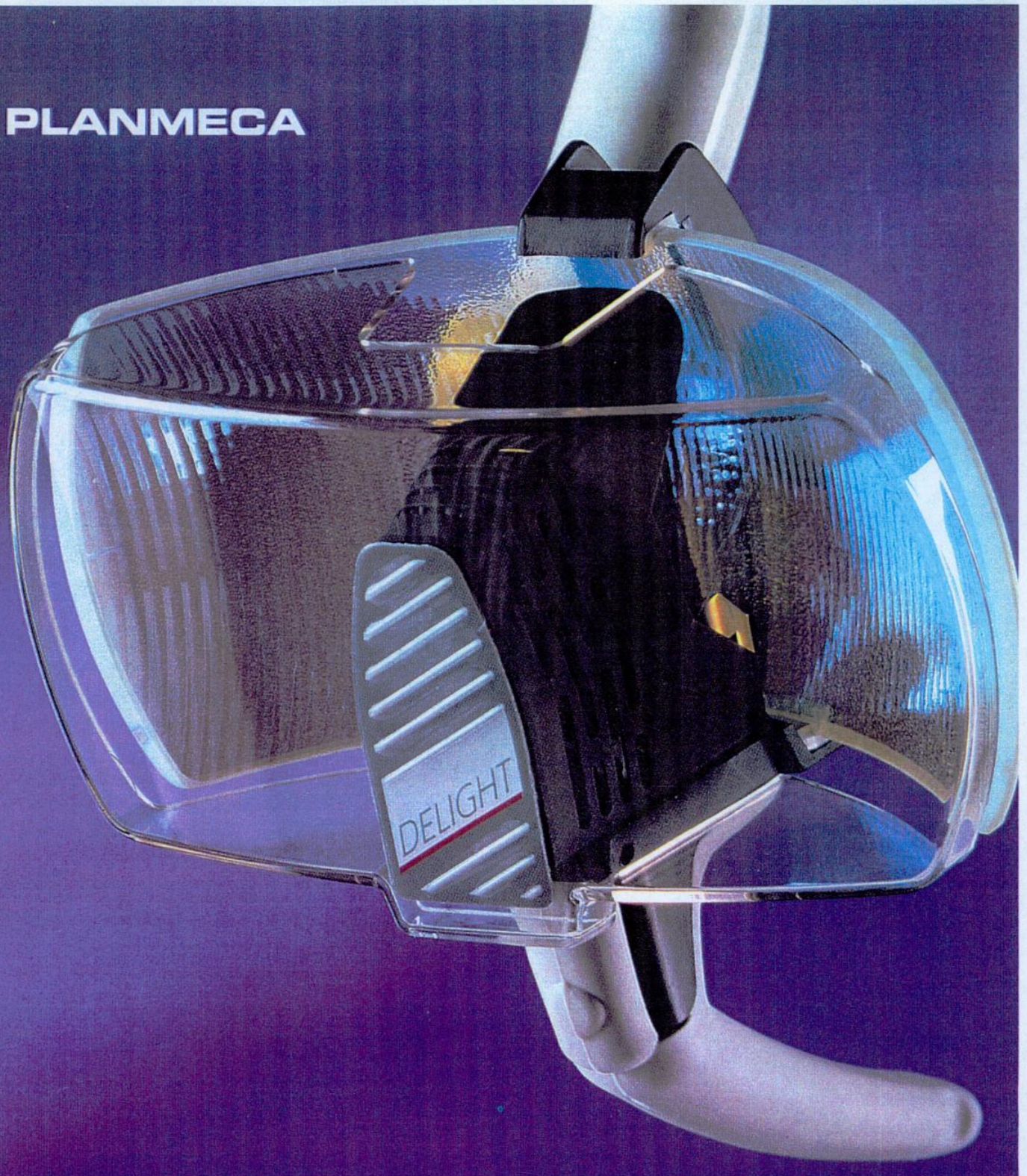
The OP-arm is also designed to be used from the spittoon side. This makes spittoon entry and instrument service simple and effortless. Unnecessary arm movements can be avoided as the light post is attached to the delivery arm, and does not obstruct the arm movements.

Spittoon

- Integrated with chair.
- All unit controls and filters located inside the unit for surface hygiene.
- Optional water heater to supply warm water for instruments and filling the glass.
- Porcelain spittoon bowl can easily be removed and washed in a dishwasher.
- Glass and bowl rinse tubes can be removed for cleaning.
- Integrated glass stand.
- Spittoon body of cast aluminium, galvanized steel, finished.
  with baked epoxy powder coating. Fully corrosion resistant.
- All screws, tube nipples and other fittings are corrosion resistant.

- Option: UV Water Disinfection system.
- Option: Sterile/Clean Water System or only Clean Water system.

PLANMECA



Delight

dental light

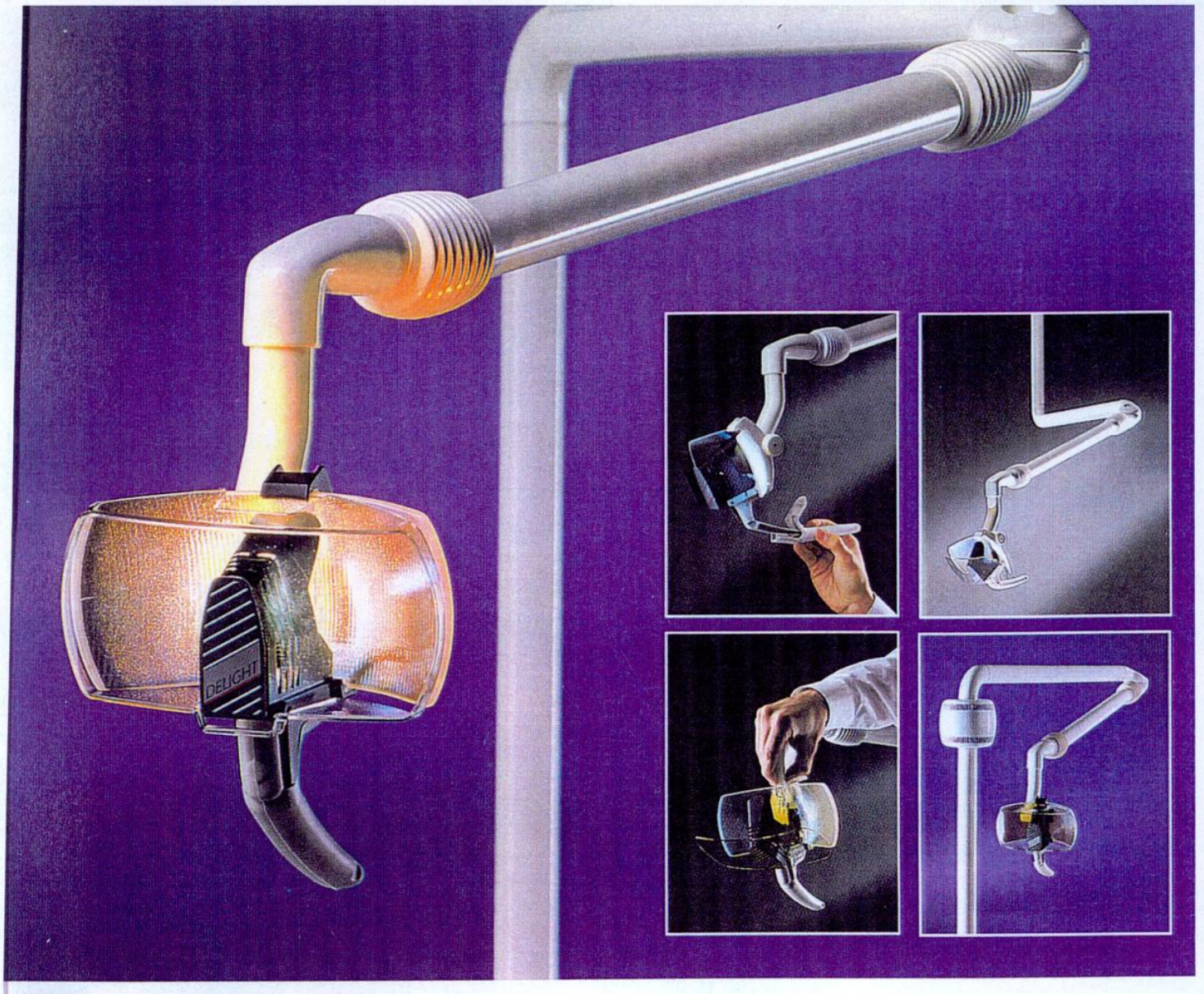
Delight control

The Delight operating light can be turned on and off from the light´s switch or from the unit control panel.

Preset intensity is adjusted by selecting the desired brightness from the foot control and by storing this value (70–100%).

Preset intensity can also be adjusted by pressing the switch of the light or by pressing the light key. Intensity will increase as long as the switch is activated. For dimming, the light switch must be released and then pressed again. The advantage is that during treatment the light can be adjusted easily.

The operating light is dimmed automatically when the polymerisation light instrument is lifted from the holder. The light is also dimmed automatically by 10% every time the chair moves.



Delight illumination

HIGH QUALITY ILLUMINATION

A good dental light is essential if first-class work is to be done accurately and efficiently. The Delight dental light is a small, powerful lamp specially designed for modern dentistry. It produces a cool, natural, shadowless light that is easy to work with and minimizes eye strain during long working periods. The specially designed faceted reflector illuminates the whole operating area uniformly and brightly and passes most of the infrared radiation away from the treatment zone.

COMFORT

The Delight dental light is compact and well-balanced and is easy to move and position. The arm is smooth, silent and judder-free and does not drift or move out of position. The exceptionally long reach assures that even the supine lingual region is easily illuminated.

- focus adjustment without tools
- shadowless and even illumination field
- optimum colour temperature of 5,000 K at 20,000 lux
- illumination intensity range from 8,000 to 28,000 lux
- exceptionally even illumination field 10 x 24 cm/80 cm.
- construction allows the highest level of hygiene
- concealed on/off switch
- epoxy paint finish which is not affected by disinfectants

HYGIENE

The silicon rubber handle sheath can be removed and autoclaved up to 135 °C. Its surface is resistant to all commonly used disinfectants including alcohol based ones.

CLEANING

The Delight dental light is very easy to keep clean. The protective fascia can be removed for cleaning and the reflector can be simply wiped clean. The arm is round and smooth with highest finishing grade for fast cleaning.

BULB CHANGE

The Delight dental light uses a standard halogen long-life 24V, 150W bulb which is available worldwide. It is quick and easy to change and no tools are required.

OPTION

A patient mirror, giving the patient the possibility to follow the dental care, is available as an option. The mirror can be easily installed without any tools.

INSTALLATION

The Delight dental light is available in two versions – a unit mounted and a ceiling mounted version. A separate transformer is available so that the light can be installed to dental units that do not have an adjustable 24 V power outlet.

PLANMECA

Planmeca Oy
Asentajankatu 6, 00810 Helsinki, Finland
Tel. 358-0-759 05 500, fax 358-0-759 05 555

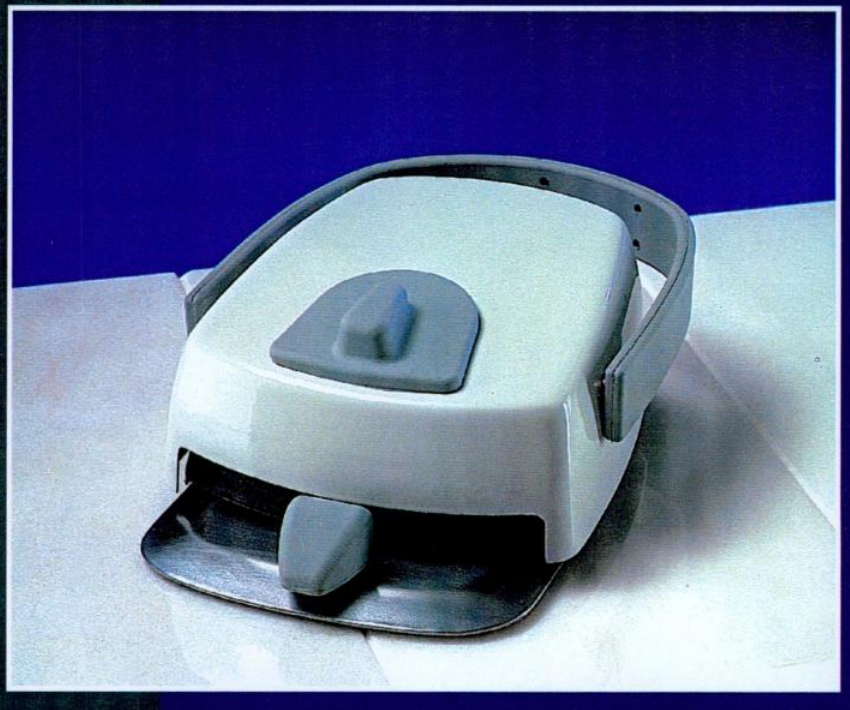
Planmeca GmbH
Auf der Hüls 183,
52068 Aachen, Germany
Tel. 49-241-16009-0
Fax 49-241-1600990

Planmeca U.S.A. Inc.
362 Balm Court,
Wood Dale, IL 60191-1273, USA
Tel. 1-708-595-7077
Fax 1-708-595-7135

Planmeca Italia srl
Via Arrio 75/i,
33030 Buia (Udine), Italy
Tel. 39-432-963300
Fax 39-432-963130

389004/9510 en

Prostyle compact



4. Foot control

Foot control

One integrated foot control for chair and unit using completely new technology.

Foot control is ergonomic, versatile, stable and extremely reliable.

Features include:

- Symmetrical design
  (can be used from left to right or from right to left)
- Hygienic and compact
- Less mechanical parts inside (50% reduction) and no wearing parts
- Recognition of the foot lever position reading by capacitive system (traditional microswitches, hall detectors eliminated)
- No adjustments needed
- Cast zinc - heavy and stable body, will not corrode
- Will not move unintentionally on any floor surface due to weight and silicone studs
- Lifting bar protects the finish when in rest position.

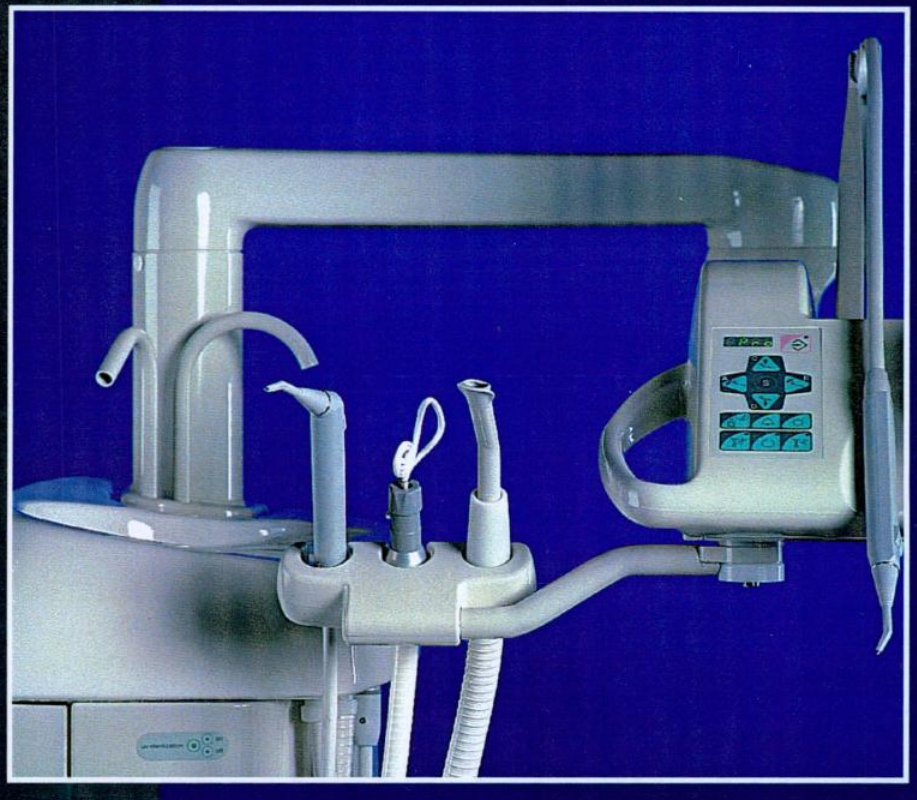
Controls include:

1. Instrument activation
   (from mid position to left or right, short push)
2. Instrument control
   (speed or power, from mid position to left or right)
3. Polymerisation light activation
   (activation of foot lever to any direction, if not released the cycle will be repeated)
4. Chip blow activation (long push of lever down)
5. Spray on/off (with sound indication, short push of lever down)
6. Chair manual control
7. Chair automatic control, including spit position
8. Bowl rinsing and glass filling
9. Door open or nurse call

Foot control

- Electric foot control operates all instrument functions (not micromotor reverse), plus chair and unit.
- Control operations:– Speed/power, proportional.
  – Spray activation.
  – Chip blow activation to dry the cavities.
  – Integrated control for chair with automatic (4 + spittoon position), manual and stop movements
  – Spittoon functions, bowl rinse/glass fill
- No wearing parts (uses capacitive system).
- Small compact size.
- Symmetrical lever operation, use from either side.
- Will be compatible also with the earlier PM dental units.

Prostyle compact



6. Bowl rinse/glass fill system
7. Suction system

Bowl rinse/glass fill system

Functions:

All practice related functions can easily be performed from the control panel or "hands free" from the foot control. All necessary functions are easy to activate.

The glass is filled and the bowl is rinsed after the control button is pressed normally . The flow rate of water can easily be adjusted from inside the spittoon and and the duration can be programmed by the user. The time limits for rinsing are 2-240 sec. and for glass fill 2-10 sec. No service calls or adjustments from the PCB are needed. Bowl rinsing will start automatically after the glass is filled.

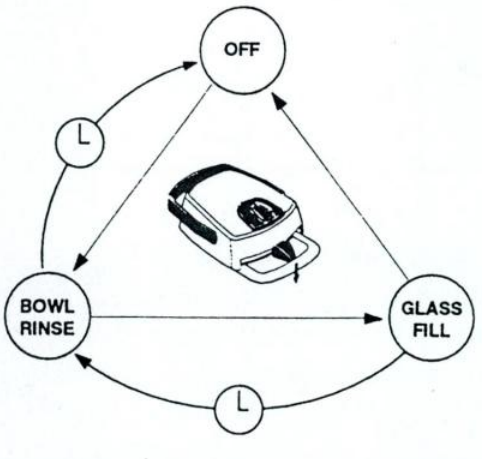
If "manual " filling of glass is desired, it can be done by keeping the button pressed continuously for over one sec. The filling is finished when the switch is released (bowl will not be rinsed).

1. Normal touch of the button (0.5 – 1 sec): glass will be filled and bowl rinsed with timers.
2. Short touch (under 0.5 sec): One touch will rinse the bowl only. The second short touch starts the glass filling and the third touch stops the function (see figure below).
3. Long touch (over 1 sec) will "manually" fill the glass only.

When no instrument is active, the glass fill/bowl rinse can be controlled from the foot control in the same manner as from the finger switch by pressing the lever down. The functions are identical to finger switch.

The following figure shows the order of the functions with or without timer.

The glass stands on the porcelain bowl and if overfilled, excess water runs into a built in drain. Since the porcelain bowl can be lifted and removed for cleaning there is a separate safety drain for the glass fill and rinse tubes. The advantage is, that if the these are accidentally operated when no bowl is in place, water will still run into the drain. Fill tubes are removable for easier cleaning.



Suction system

The suction hoses have a hygienic and ergonomically placed holder which brings the suction to a natural place for users.

Suction arm is placed on the left side of the instrument console, allowing easy ergonomic reach by the assistant or by the dentist who is working alone. A traditional assistant suction arm is offered as an option and it is fitted to the side of the spittoon. Both types of suction holders provide better support for the hoses when they are turned 180° around.

The holder has three places: two for suction hoses and one for optional assistant syringe.

Standard features:

High Volume suction handpiece
Low Volume suction handpiece

Optional features:

Water operated saliva ejector
Assistant 3-way syringe or
Assistant 6-way syringe

Suction is automatically activated when one suction handpiece is lifted from the holder and interrupted when both handpieces are back in the holder. There are no holes, no activation switches and no need for calibration, since the induction recognition works fully automally. Smooth surfaces of the holder are also easy to keep clean.

The High Volume suction handpiece (patented PM design) is ergonomic and hygienic, and contributes to a reduced noise level in the operatory.

Suction system alternatives:

1. Saliva ejector suction (water operated only)
2. Dry suction system with built in Microvac air/water separator
3. Wet suction system
4. Centrifuge separator system Metasys
5. Centrifuge separator system Dürr

Note: The completely new wet suction motor (VS 300 series) which does not consume water for its operation, developed by Dürr, works well together with the Wet type Prostyle unit.

Aspiration System

- Standard suction tube holder attached to the instrument console.
- Two suction hoses as standard:
  1. Vacuum-operated saliva ejector
  2. High Volume Suction
- Optional suction arm extendable, can be adjusted horizontally and vertically.

Operation:

- Suction is automatically activated when the hose is lifted from the holder.
- Suction holders can be turned 180° to support hoses, for better ergonomies
- Integrated activation switches, hygienic design.

Nozzles:

- Patented High Volume Suction nozzle opens automatically when tilted, closes automatically when released allowing temporary stopping of suction during the operation if necessary.
- Small saliva ejector nozzle with adjustable suction control.
- Suction nozzles can be removed and autoclaved at 135 °C (275°F).

Suction hoses:

- Removable, with quick connectors.

Options:

- Water-operated saliva ejector is available as an option or
- Assistant 6-function syringe is available as an option.

Hygiene

Infection control has been the object of special attention in the Prostyle Compact unit. All details of the unit were designed with hygiene as one important criteria. The hygiene concept aims at creating a clean and hygienic environment for the patient, dentist and assistant without compromise. All unit surfaces are easily kept clean due to the design and material selections. Internal hygiene and prevention of cross-contamination meet a standard seldom reached even in more expensive units.

Surface hygiene concept:

- Maximized hands-free controls
- Membrane covered tactile switches
- Use of non-corrosive metal parts with easy-to-clean epoxy paint finish
- Smooth lines and rounded edges
- Floor area kept clean by integrated design of the unit
- Absence of rubber or plastic bellow joint covers
- Hygienic removable porcelain cuspidor bowl
- Seamless chair upholstery
- Seamless suction holder (no switches on the surface)
- Autoclavable light handle/switch cover

Instrument arms:

- Smooth, seamless instrument bridge cover
- Quick connect instrument arms, removable, autoclavable
- Quick instrument hose surface cleaning, removable for daily hygiene
- Quick-Connect instrument hoses
- Silicone covered smooth hoses
- Removable suction hoses
- Autoclavable suction handpieces

Internal hygiene concept:

- All instruments or their covers are autoclavable (except polymerization light)
- Automatic instrument hose flush system (New in PM units)
- Anti-Contamination barrier for turbine - prevention of microbial contamination of drive air lines by a backflow prevention device - unique (patent pending)
- Non-return valves for water spray systems

Additionally the unit can be supplied with the following extra systems:

- Sterilization for main water supply (option), to eliminate all bacteria, viruses and fungi = PM UV Disinfection System
- Sterile water system
- Clean water supply from stainless steel, sterilizeable container (option) = PM Clean Water System
  (Note: Internal tubings can be disinfected with Sterile or Clean Water system)
- Centrifugal amalgam separation for over 96% separation rate of mercury.

Hygiene maintenance is made easy in this unit. The selection of materials for the frame and the design of all details are with hygiene in mind. Many proven internal hygienic features plus some new ones make this unit free from compromises.

The majority of frame parts are constructed of cast aluminium resulting in a solid, aesthetic and functional unit.

The unit is within the reach of economy minded customers who prefer a modern unit with all the necessary features but without an endless selection of controls and features that are not required daily. However, with this unit the customers need not to compromise on reliability, hygiene or instrument performance.

Reliability and minimal need of service are requirements that have been clearly in the mind of every designer during the design process of the unit. Simplified construction and elimination of excess body elements support this goal.

The Prostyle solution: An integrated chair and unit which has over-the-patient delivery system and which is mounted to the floor. The instrument control system is based on electronically controlled proportional valves, pressure controls and a multiplexer.

Construction, coating and colour of unit

- Solid cast aluminium, corrosion free construction.
- Electroplated or hotgalvanized steel parts.
- Baked epoxy powder finish on all external metal parts is scratch and chip resistant and easy to clean. Colour off-white RAL 9002.

Mechanical construction:

Stable floor mounted and simple construction contributes to the stability of the chair and instrumentation. Body parts are of cast aluminium, for greater stiffness and attractive appearance. The chair is more stable than most cantilever type chairs, due to its side lifting mechanism and the absence of base joints. The chair can lift more than 210 kg (460 lbs).

Electrical design:

Electrical design of the Prostyle Compact unit is based on extensive experience of electronics combined with vast field experience in dental. This experience brings truly exceptional quality into the design.

The number of PCB´s has been reduced to minimum. There are only 5 printed circuit boards (in a conventional electric dental unit there are 19 or more). Advantages are much easier troubleshooting, less parts inventory required, and the fact that the technician needs to carry far less parts with him.

The error code system goes very deep to the basic errors allowing unique pinpoint accuracy in diagnostics of the unit. For example if a valve connector is disconnected it will be indicated. The reporting system of Prostyle Compact unit supports the technician giving accurate information about the real reason for malfunction. All cabeling is short circuit resistant and cable problems are highlighted. No PCB will break because of shorting.

The unit can be configurated to accept 100/115/230V~ by a simple conversion of a plug in one Pcb.

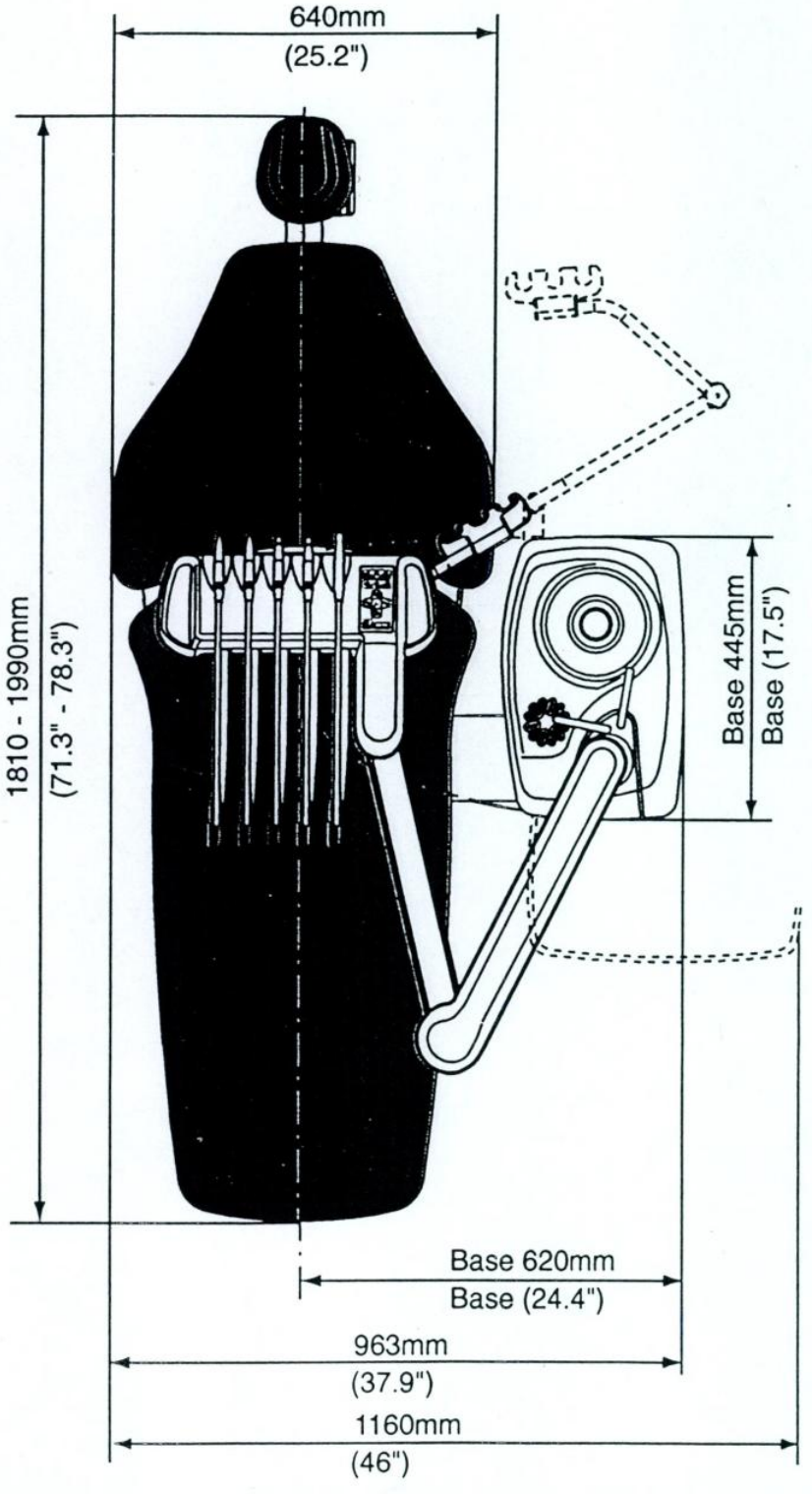
The chair position is determined with a multirevolution potentiometer which is attached to the worm gear of the motor. The position of the chair will directly determine the location, there are no pulses needed from the motors, no reference points etc.. The reliability and minimized service are the result of the new system, no more need to change motors due to lack of pulses, and the potentiometer is easy to change if necessary.

The main PCB has "satellites" which are in the foot control, suction holder and control panel. The cabling is simple with only three wires to each satellite. Wrong connecton of cables or shorting will not break anything and will be reported by the system.

Electronic communication: Serial communication between the satellites (foot control PCB, keyboard PCB, suction sensor PCB, console instrument multiplexer PCB) and the main PCB. Advantages: Simple wiring, less connectors, less contact problems, protection against static discharges, shorting and wrong connections.

The Prostyle Compact unit operates without trimmerpotentiometers. Electronic control is so accucate that correct functioning is guaranteed and the need for adjustments is minimized. No meter is needed for normal servicing.

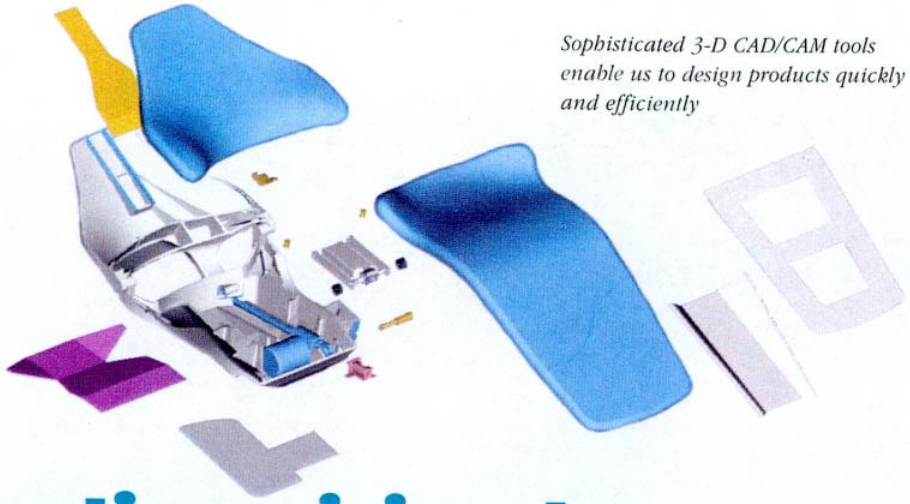
The number of cabeling hoses and nipples is minimized and the quality and strenght of cabeling is very high.


640mm
(25.2")
1810 - 1990mm
(71.3" - 78.3")
Base 445mm
Base (17.5")
Base 620mm
Base (24.4")
963mm
(37.9")
1160mm
(46")

...Appendix B

-Planmeca Company, Finland, Promotional Literature.

PLANMECA *Group*



Sophisticated 3-D CAD/CAM tools enable us to design products quickly and efficiently

PRODUCT DEVELOPMENT

Innovative product development is the key to the Planmeca Group's international success. We invest heavily in R&D (Research and Development) so that we are able to produce the best and the most advanced equipment. Investments in personnel are also vital – about 15% of the personnel at our Helsinki head office work in the R&D department. We work closely with customers, universities and research centres to determine user requirements, to analyse their future needs, and to evaluate developing techniques. By applying the latest design principles and manufacturing technologies we are able to respond quickly to changing customer needs and rapidly developing market needs.

from creative vision to design excellence

CREATIVE DESIGN

From creative idea to market reality, our R&D team designs and develops quality products that are in demand worldwide. All our products are designed to operate efficiently and reliably to make the work environment more comfortable, and the user´s job easier. As well as performing exceptionally well our products look good and offer the user real technical and functional advantages – in short, a perfect blend of form and function. This can be seen in the Planmeca Proline, Prostyle and Planmed ranges of equipment. Our R&D department is at the heart of the Planmeca Group enabling us to improve and expand our range of products and maintain our technical and competitive edge.

Planmed Sophie's heart – compact high power generator

Group

Prostyle Compact dental unit

Planmed's Sophie mammography unit

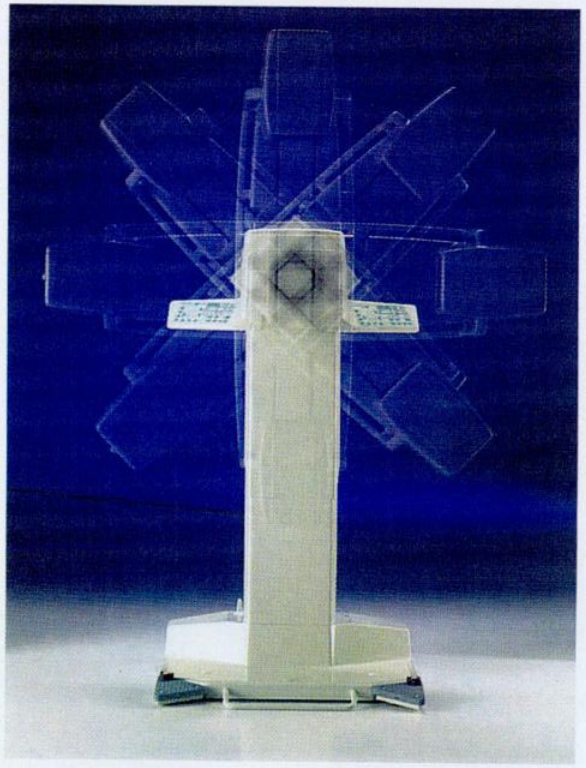
PM 2002 CC Proline Panoramic x-ray

PLANMECA Group

Three-dimensional CAD enables innovative and efficient design

modern dental and medical equipment manufacturing

Group

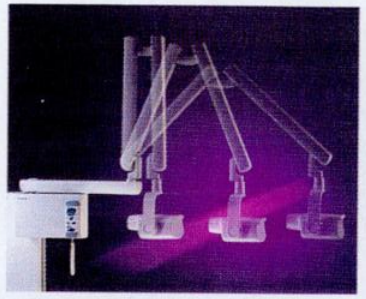


Planmed Sophie mammography unit with isocentric motorized rotation

Planmeca has established itself as one of the leading suppliers to the dental profession. Presently we export 95% of our production to more than 70 countries through our subsidiaries, representatives and dealers. Our main marketing areas are Europe, North America and the Far East. Planmeca has subsidiaries in Germany, the United States and Italy, as well as sales representatives in Iran, China and Singapore. Our distribution network is assisted by professional support staff operating from our modern 18,000 square metre Helsinki head office and factory.

PLANMED

Planmed was established in 1989 to design, manufacture and distribute advanced medical imaging equipment. Planmed achieved immediate success with the launch of the Sophie mammography x-ray unit. It is acclaimed as the most advanced mammography unit on the market featuring a unique compression mechanism and isocentric C-arm rotation. The unit can be enhanced with the Planmed Cytoguide stereotactic unit, which is a computerized biopsy needle guidance system for quality stereotactics. The Planmed Sophie is also available as a truly mobile version (Sophie Mobile) with four large wheels and integrated radiation protection shield. Planmed equipment in-corporates so many design advantages and unique features that it sets the standards by which other mammography equipment is now judged. Planmed's success is based on the same formula as Planmeca's: innovative product development, implementation of the very latest technology, ergonomic design and high standards of quality and reliability.



The Prostyle Intra intra-oral x-ray system

The Proscan linear tomography system

PM 2002 Proline chair without armrests

To guarantee consistent quality we have several fully automatic machining centres

Production line of panoramic x-rays

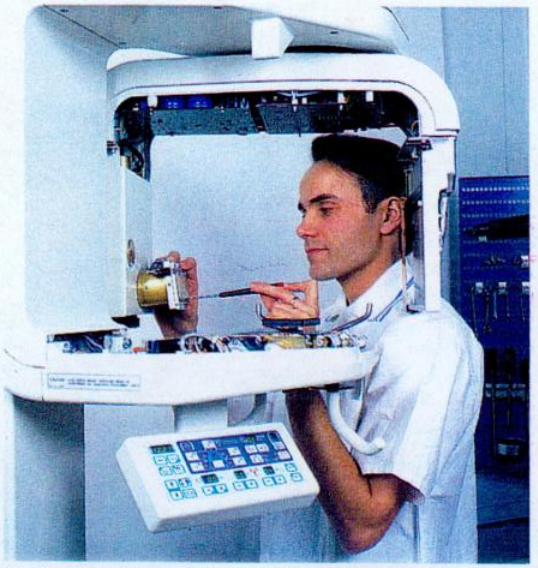
PLANMECA's Quality System

ISO 9001
Certificate awarded 1994
by Det Norske Veritas

fulfils the highest acknowledged international standards

Group

advanced technology and highly skilled personnel



Producing the most advanced panoramic x-ray

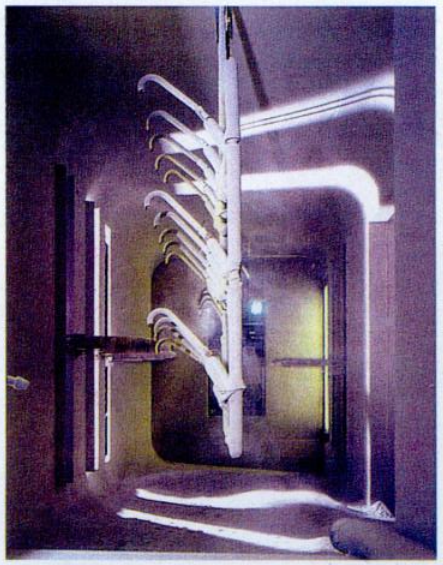
TECHNOLOGY

Innovative technology is substantial in the manufacture of modern dental and medical equipment. We employ the latest computerized technology in all production procedures, ranging from automatic machining centres and painting line to testing facilities and quality control.

QUALITY

For Planmeca and Planmed product quality is more than just good materials and excellent finish. Our management has defined the companies' quality policy which is understood, implemented and maintained at all levels in our organization. Planmeca's and Planmed's quality systems have been certified against the international standard ISO 9001.

All our products are subject to rigorous quality control during manufacture and exhaustive testing before they leave the factory. Only in this way can we ensure that customers will receive products of the highest quality.

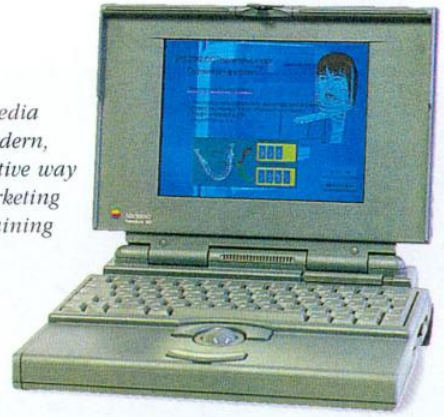


Our own painting line ensures the finest quality finish

Product demonstrations are the way to success

Group

Multimedia is a modern, interactive way for marketing and training



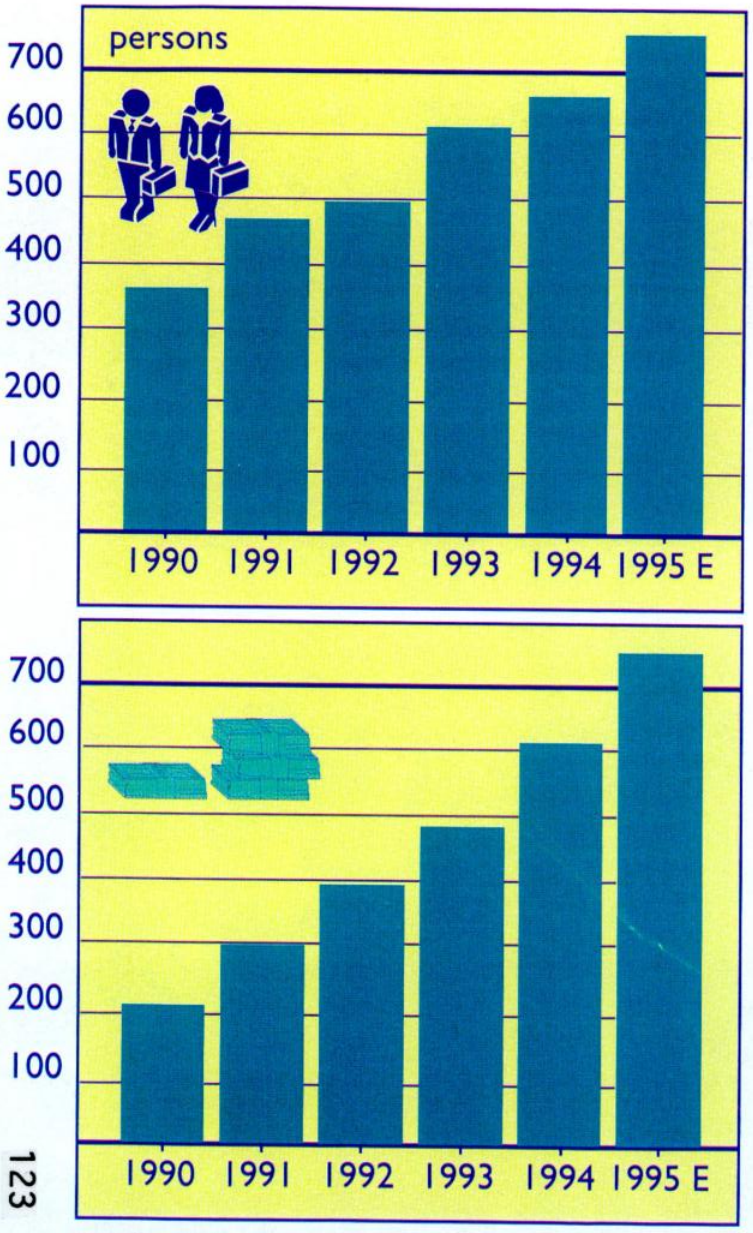
extensive sales and marketing support

Our highly acclaimed multimedia presentation is a modern way of offering end-users complete company and product information. This advanced customer oriented, interactive system can be used for customer training and demonstrations. Multimedia is just one example of our total commitment to our customers, products and the future.

SALES SUPPORT

Top quality products demand the highest standards of sales support and after sales service. Our skilled sales and marketing personnel regularly give sales and training seminars and product demonstrations to ensure that all our dealers, customers and end-users are fully aware of our range of products and their advanced features. In addition, an extensive worldwide after sales network ensures that all Planmeca and Planmed equipment can be quickly and efficiently serviced and maintained.

Training seminars are an important part of our marketing strategy



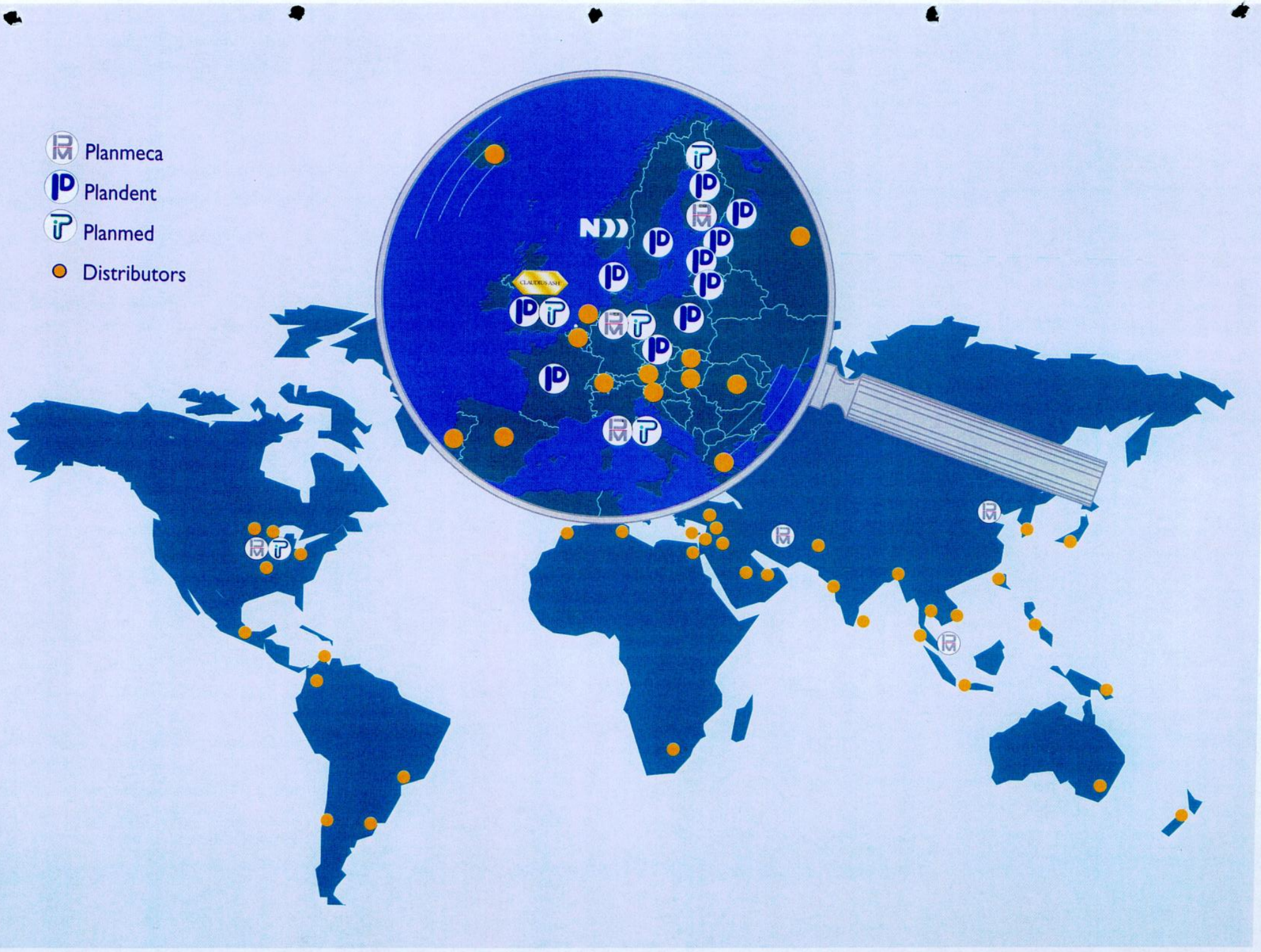
in million FIM

Planmeca Group in figures

During its history, the Planmeca Group has constantly increased its turnover by an average yearly growth rate of about 30 %. Our steady growth is based on the advanced standard of technology of all PM products, and our highly professional and efficient personnel, who ensure precise deliveries and reliable after-sales service to PM customers around the world.

The expansion of the Plandent network is due to the capability of Plandent companies to distribute efficiently a wide range of high quality dental products – at competitive prices.

Group



PLANMECA

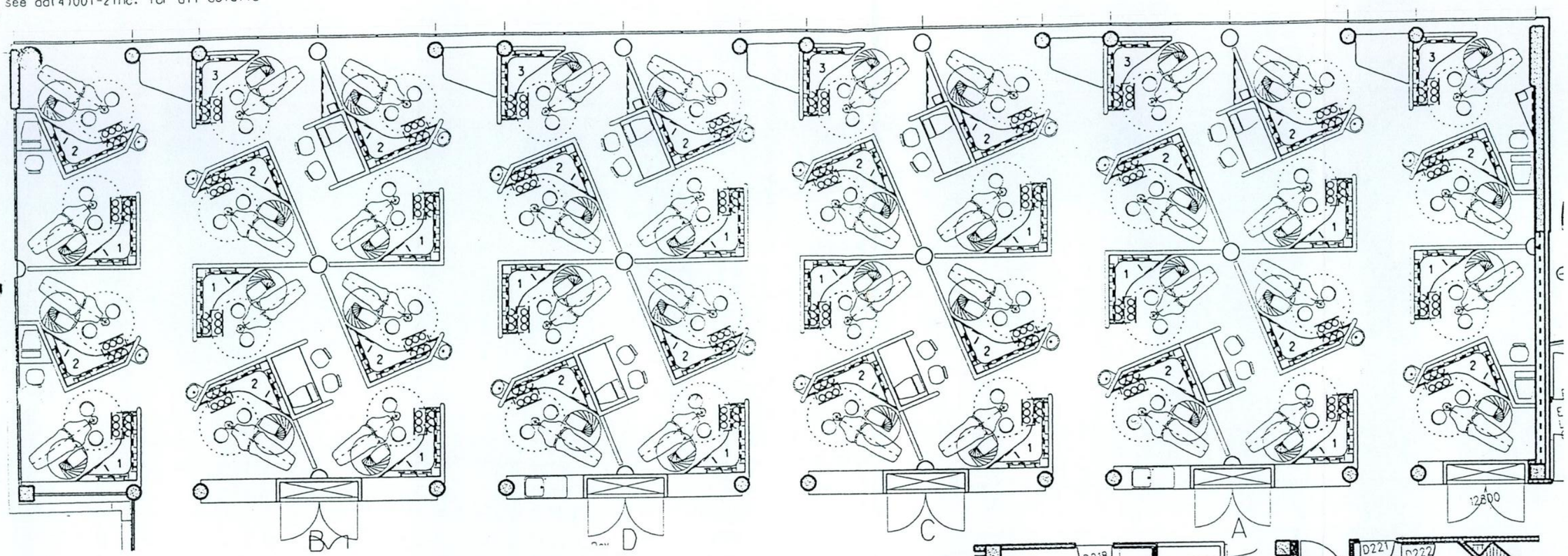
Gro

The Planme Group's headquarter foreign subsidiaries, sales offices and

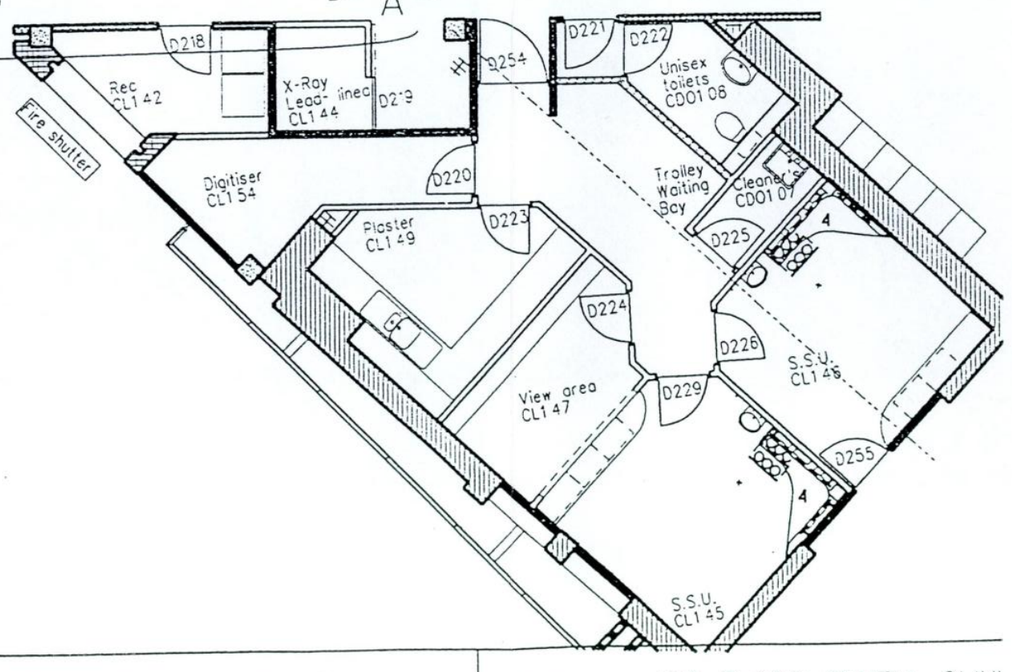
...Appendix C

-A.B.K. Architects Plans For Interior Design of New Dublin Dental Hospital.

For Clinical worktop/storage unit details
see aa(4)001-2inc. for all details



Clinic End of Corridor Storage Unit Types
see a(4)147-9inc. for all details



Ref.	Date.	Revisions.
	06.11.96	Clinical worktop types identified by type No. and SSU added

Ahrends Burton and Koralek
Architects
Unit 1 7 Chalcot Road, London NW1 8LH
0171-586 3311 Fax 0171-722 5445

DUBLIN DENTAL HOSPITAL

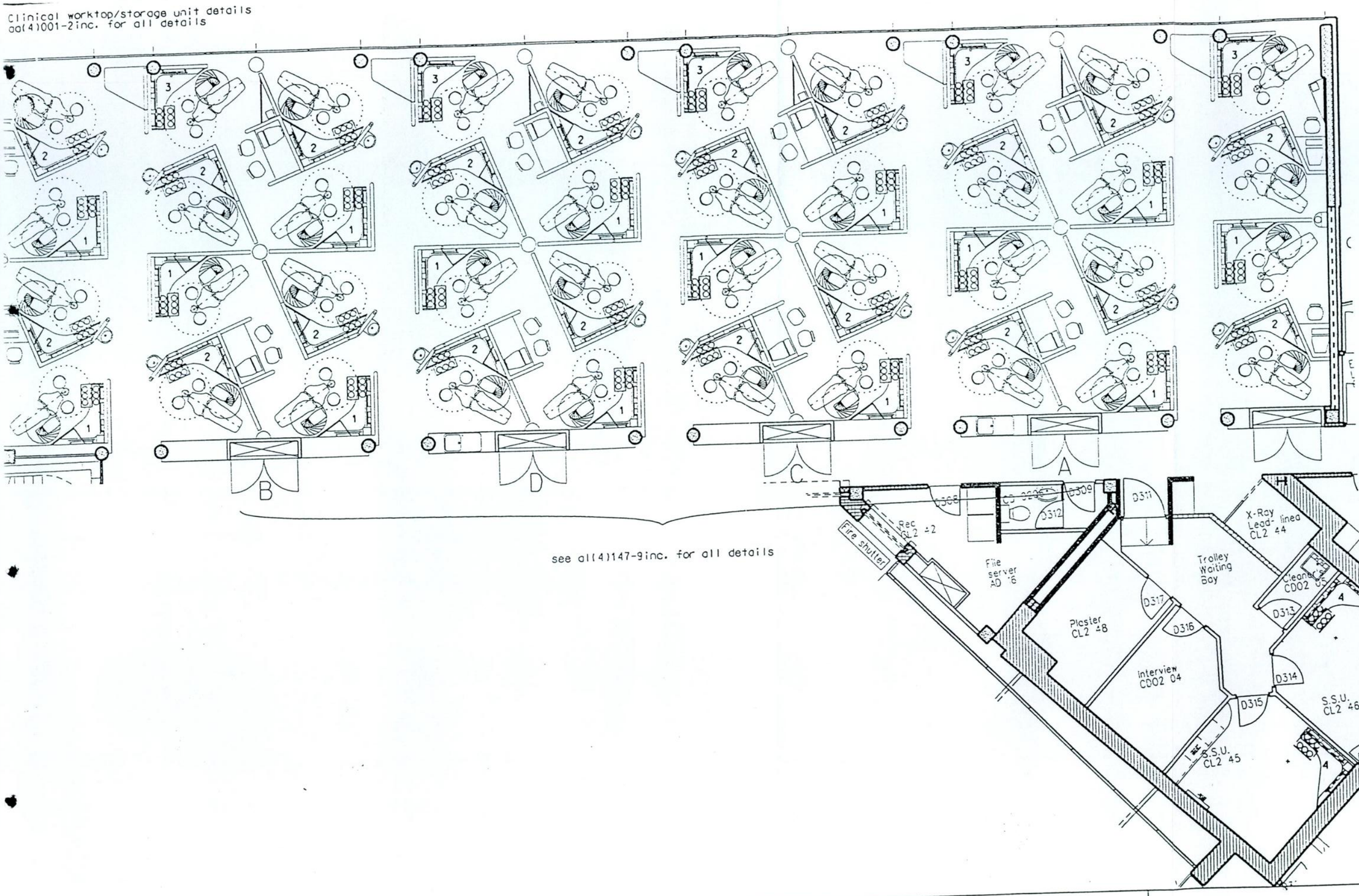
Title: 1ST FLOOR DENTAL CLINI

Scale: 1:100 Date: 17:

Drawing number:

399 AL(4)140 A

Clinical worktop/storage unit details
aa(4)001-2inc. for all details



see a(4)147-9inc. for all details

Ref. Date. Revisions.
a. 06.11.96 Clinical worktop types identified by type No. and SSU added

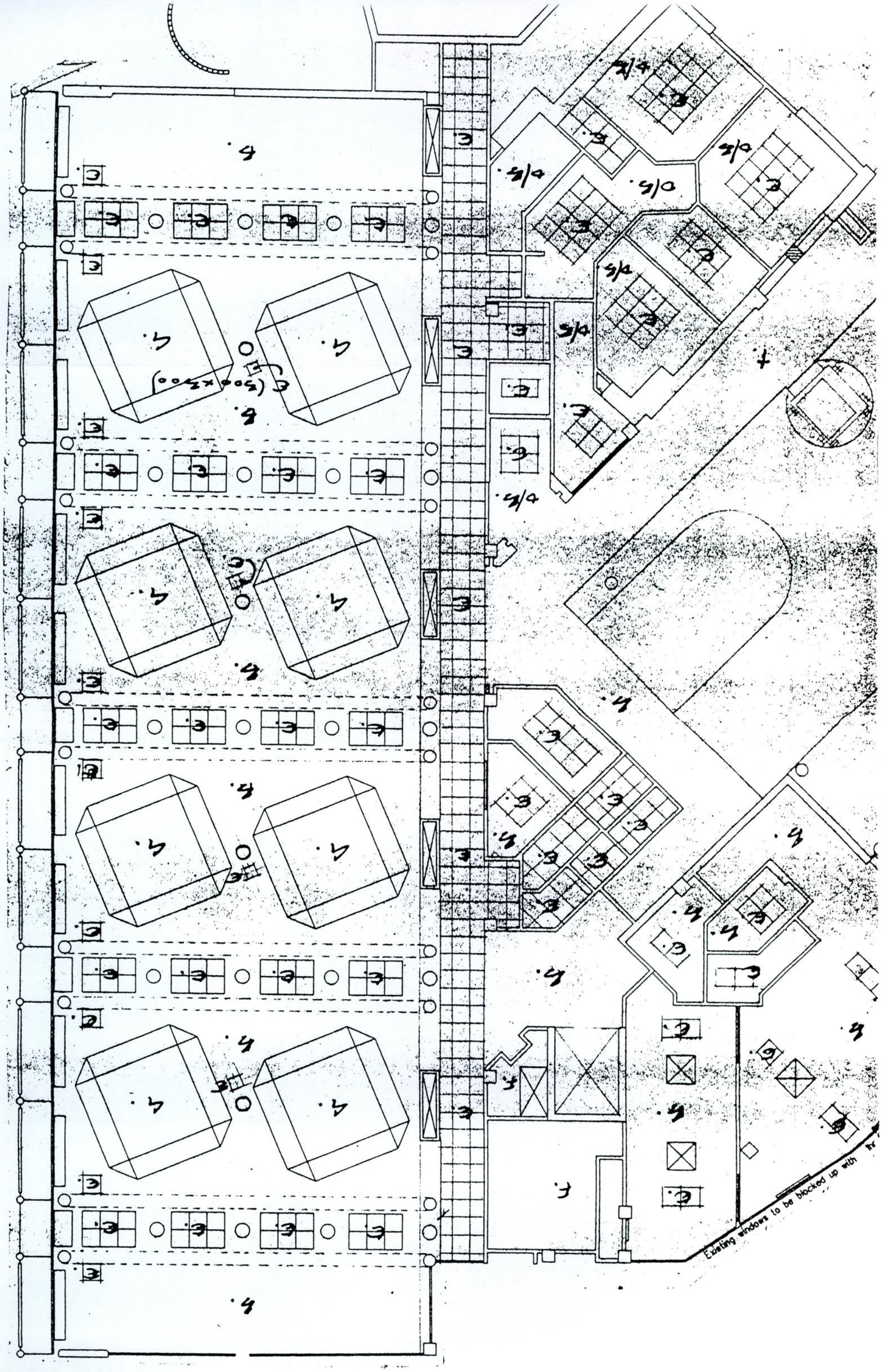
Ahrends Burton and Koralek
Architects
Unit 1 7 Chalcot Road, London NW1 8LH
0171-586 3311 Fax 0171-722 5445

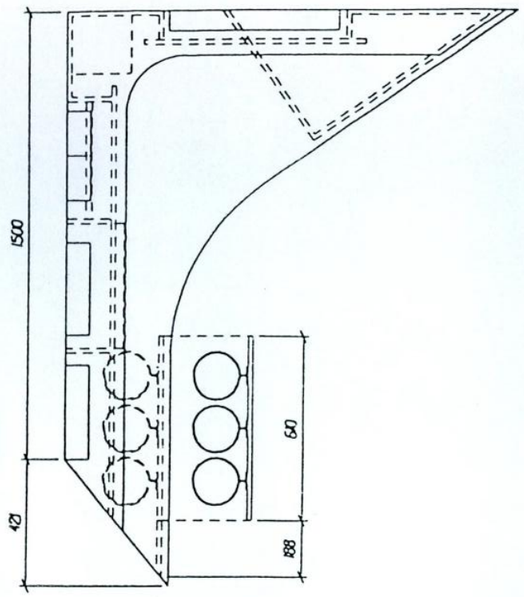
DUBLIN DENTAL HOSPITAL

Title: 2ND FLOOR DENTAL

Scale: 1:100 Dat

Drawing number:
399 AL(4)141 A


Existing windows to be blocked up with

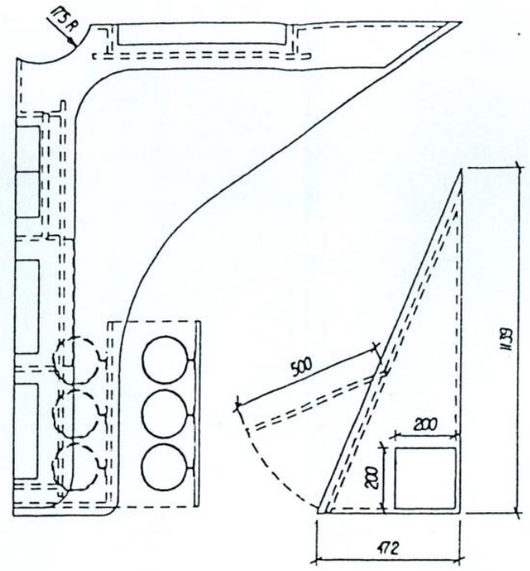


UNIT 2

Clinical unit with splayed end.

This unit does not require end facia board.

Waste disposal panel is to have a fixed extended panel to meet the partition



UNIT 3

Clinical unit with cutout.

This unit does not have a shelf for the sharps box or a lower storage cupboard.

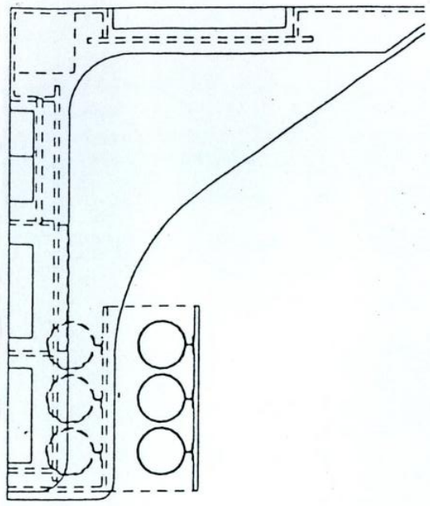
All panels are to be cut into the concrete column.

UNIT 3A

This storage unit is to accompany unit 3.

The unit is 500mm high with one adjustable internal shelf and a fixed shelf for the sharps box.

The unit is supported as unit 1(raised off the ground) supported by 2No. partitions.



UNIT 4

Clinical unit without storage.

This unit is as Unit 1 however does not have a storage cupboard below.

Ref. Date. Revisions.

Note:
This drawing is to be read in conjunction with aa(4)001.
All materials and details are as UNIT 1, unless otherwise stated.

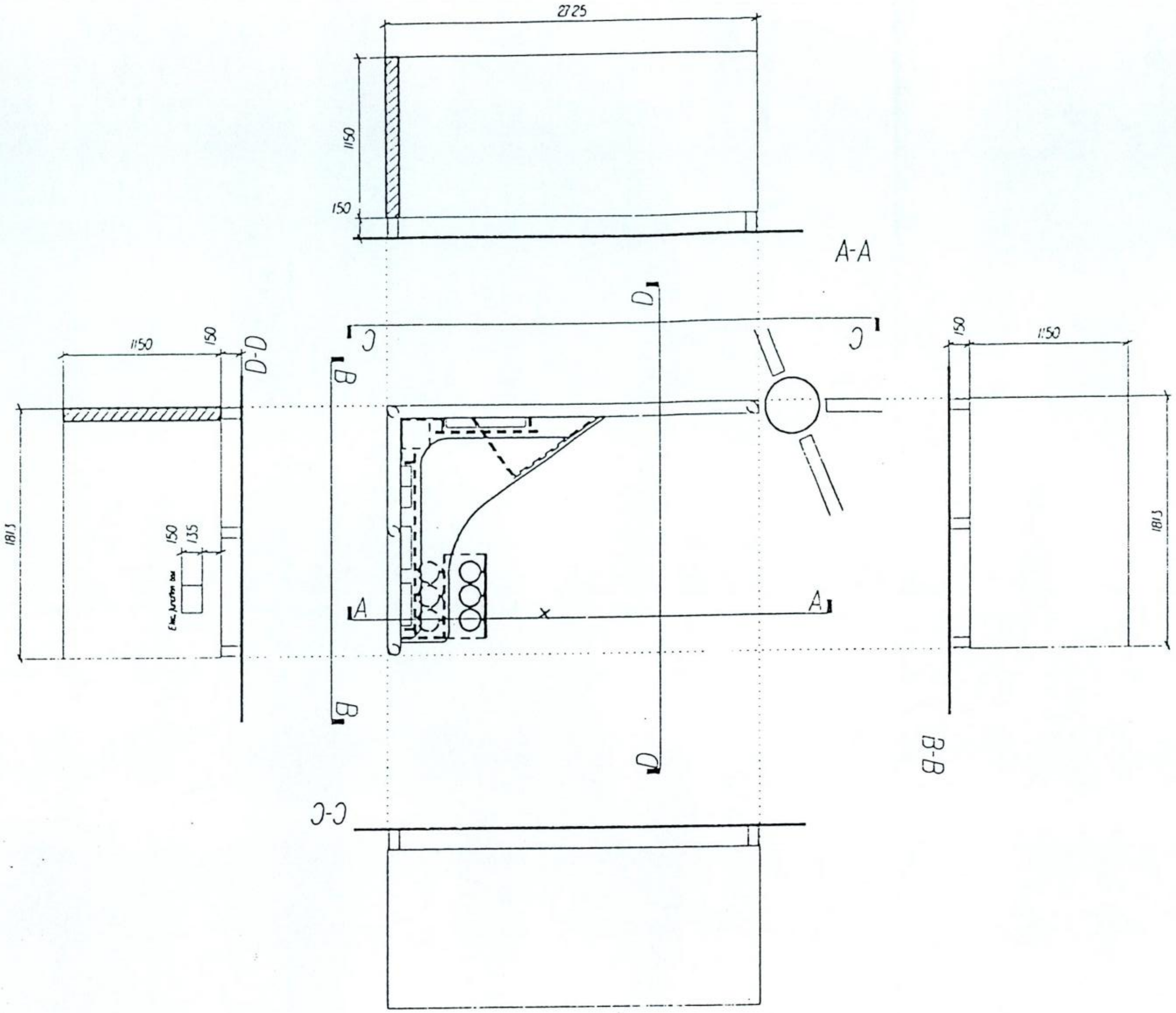
Ahrends Burton and Koralek
Architects
Unit 1 7 Cholcol Road, London NW1 8LH
0171-586 3311 Fax 0171-722 5445

DUBLIN DENTAL HOSPITAL

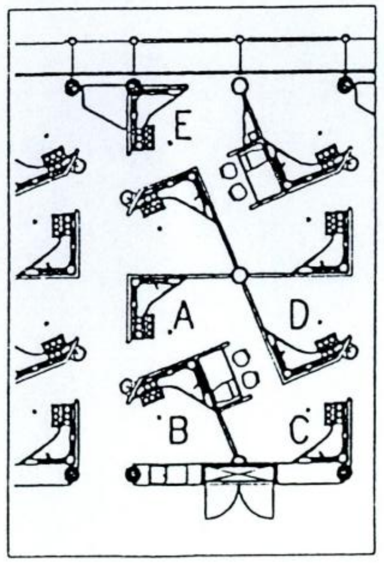
Title: CLINICAL WORKTOP/STORAGE

Scale: 1:20 Date:

Drawing number: AA(4)002



GROUP 1.EQUIPMENT REQUIRED
Dental Unit, worktop, services and fittings
Type 1 see aa(4)001/2
Coat hook.

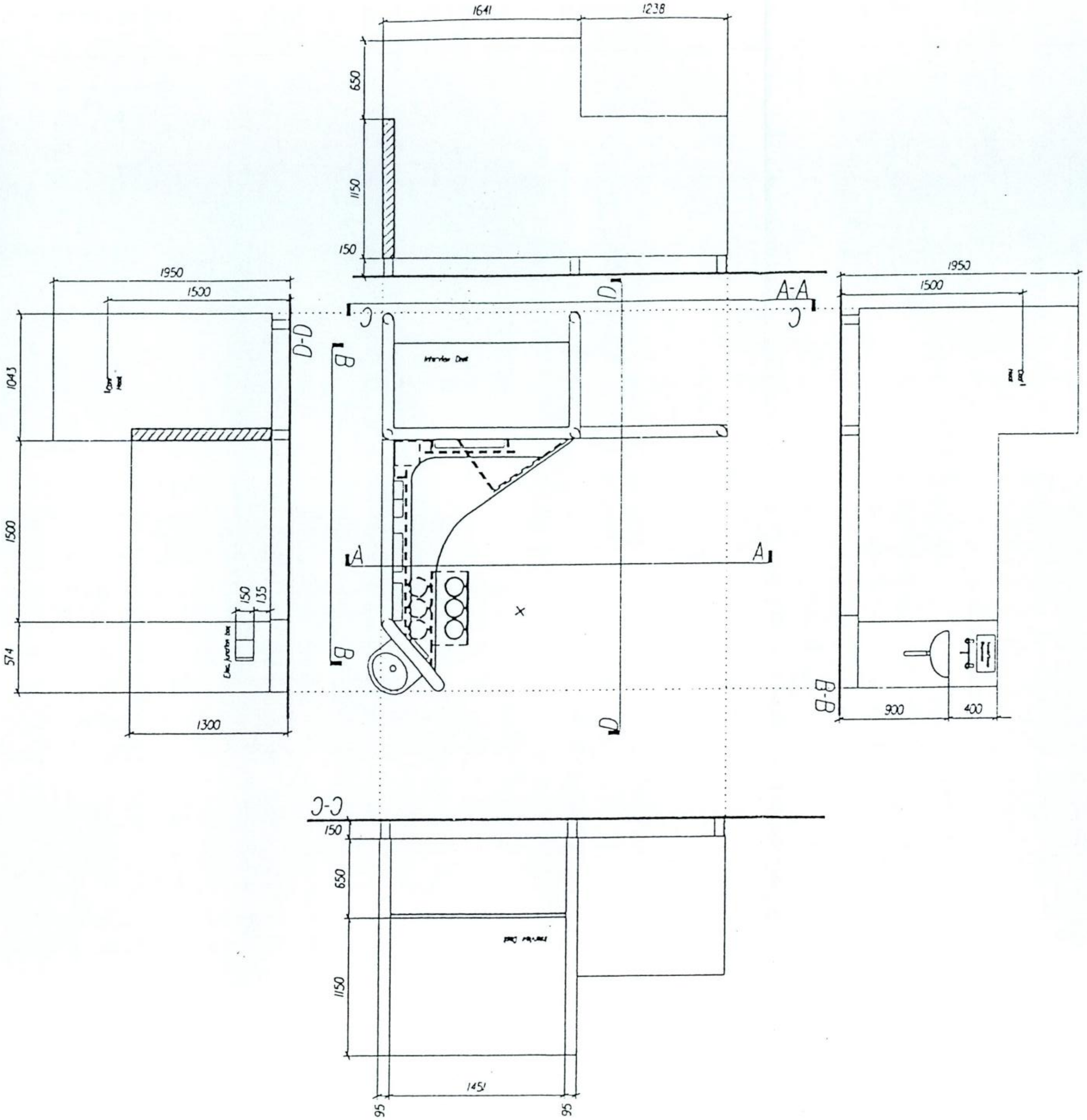


Key to cubicle layout

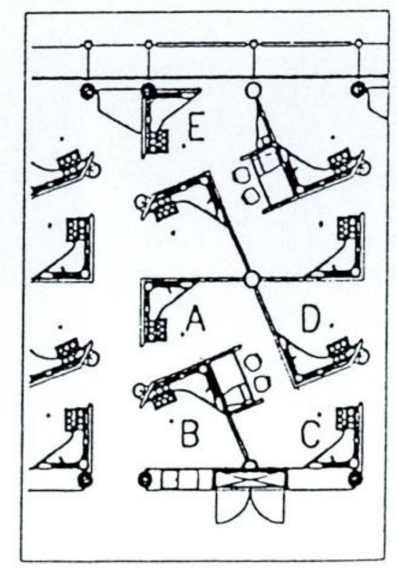
NOTE: For partition details see drawing Nos AA(7)175/178

Architects
Dublin Dental Hospital
GROUP 1 EQUIPMENT. PHASE 2

Title Cubicle Type A
Scale NTS
Drawing number 399/AL(4)142



GROUP 1.EQUIPMENT REQUIRED
Dental Unit, worktop, services and fittings
Type 2 see aa(4)001/2
Intergrated washand basin/towel and soap d
Coat hook.



Key to cubicle layout

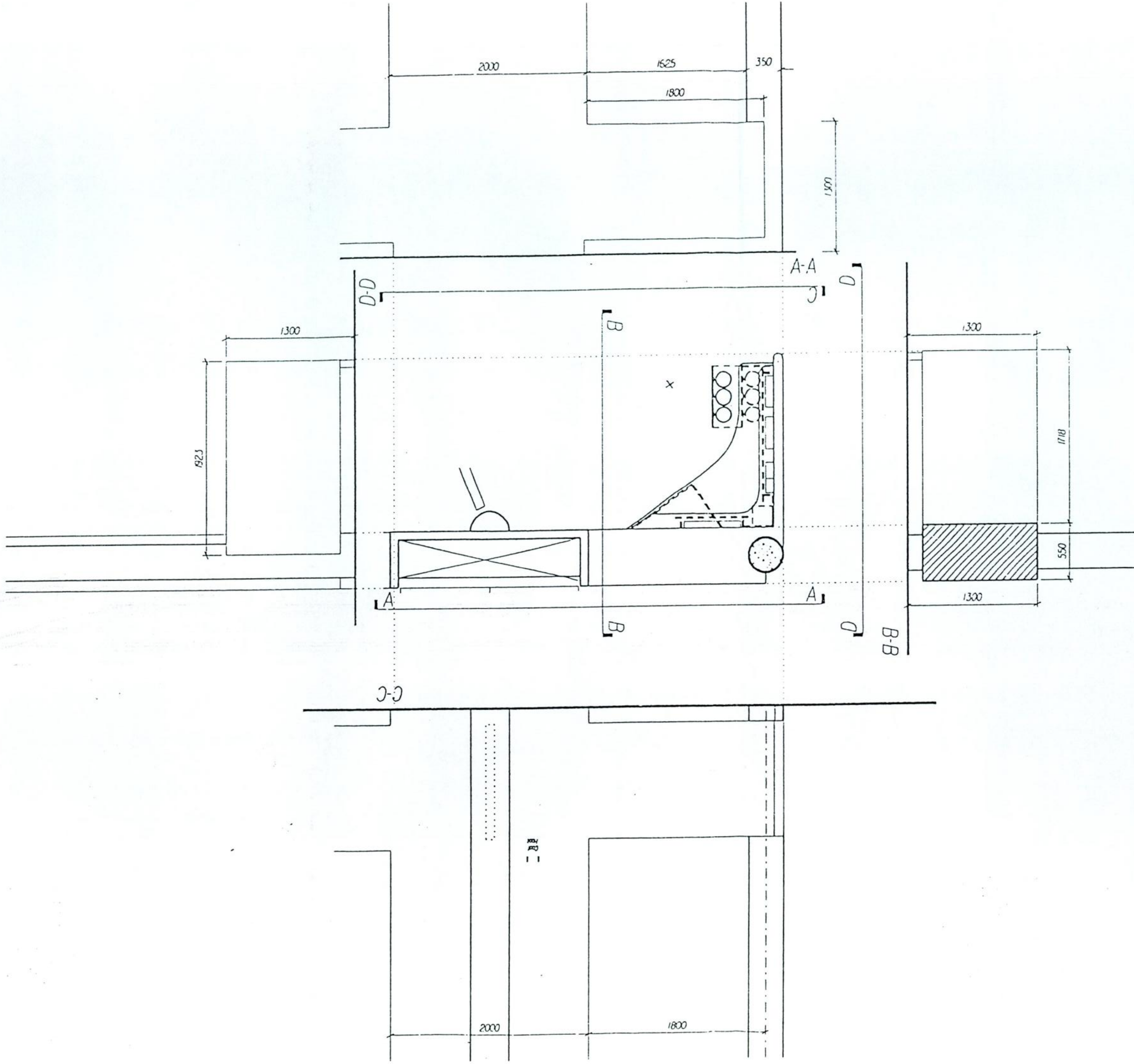
NOTE: For partition detalls see drawing Nos AA(7)X75/178

Title Cubicle Type

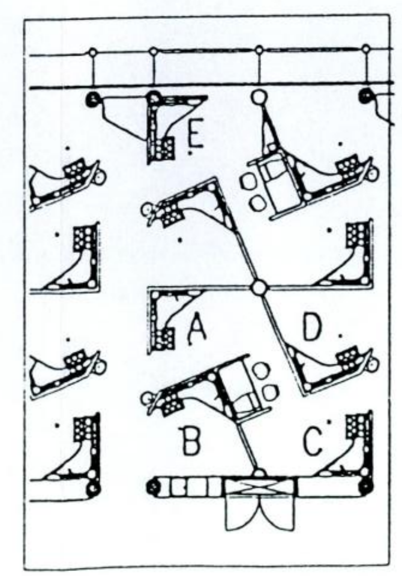
Scale NTS

Dublin Dental Hospital
GROUP 1 EQUIPMENT. PHASE 2

Drawing number
399/AL(4)



GROUP 1.EQUIPMENT REQUIRED
Dental Unit, worktop, services and fittings
Type I see aa(4)001/2
2No.Coat hook.



Key to cubicle layout

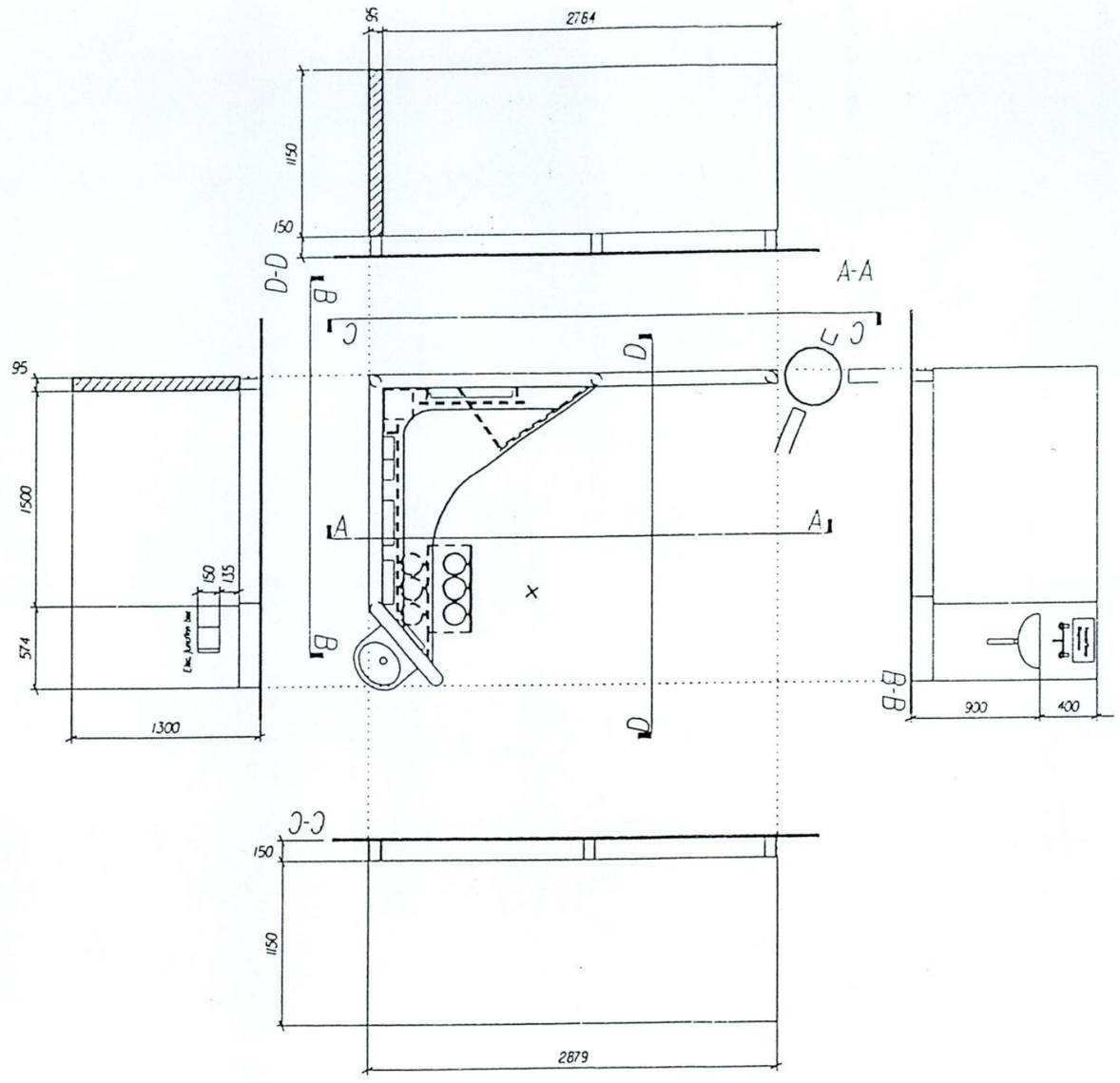
Rev. Date Revisions	Drawn by	Checked by
[illegible]		
[illegible]		
[illegible]		
[illegible]		

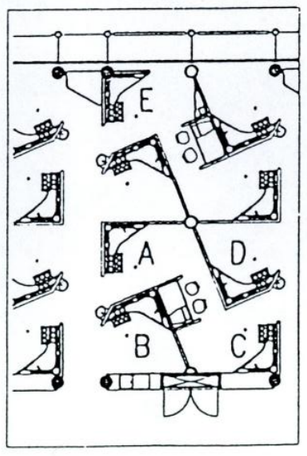
Note: concrete column to have projection cast insitu to recieve partition

NOTE: For partition details see drawing Nos AA(7)175/178

Architects Unit 1 7 [illegible] Road, London [illegible] 0171-[illegible] Fax 0171-[illegible]	Title Cubicle Type Scale N.T.S.
Dublin Dental Hospital GROUP 1 EQUIPMENT, PHASE 2 [illegible]	Drawing number 399/AL(

GROUP 1.EQUIPMENT REQUIRED
Dental Unit, worktop, services and fittings
Type 2 see aa(4)001/2
Intergrated washand basin/towel and soap dispense
Coat hook.





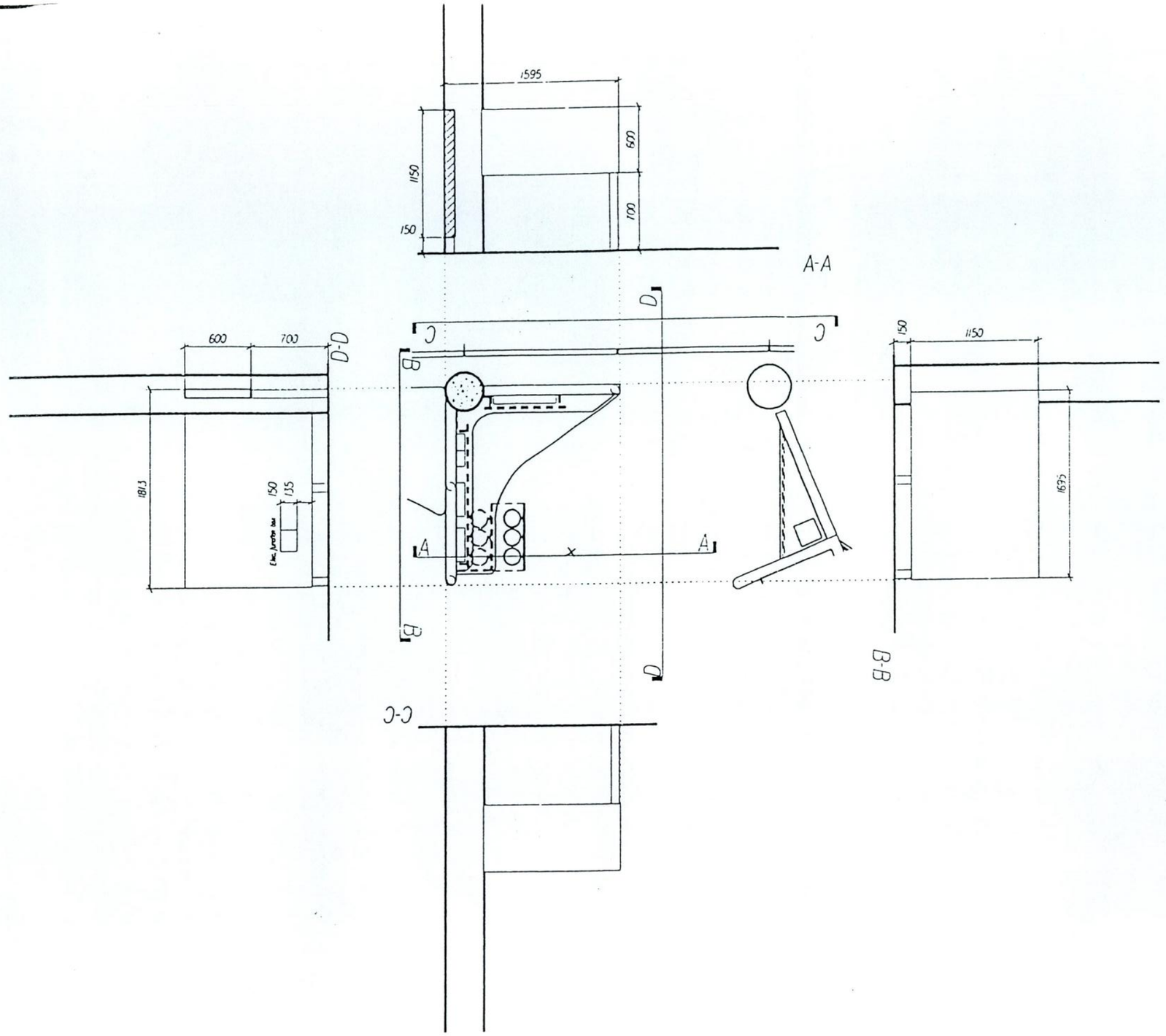
Key to cubicle layout

NOTE: For partition details see drawing Nos AA(7)175/178

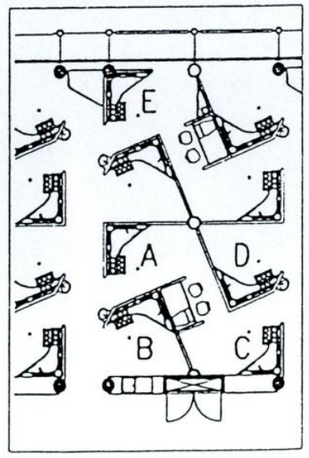
Dublin Dental Hospital
GROUP 1 EQUIPMENT, PHASE 2

Title Cubicle Type D

Drawing number
399/AL(4)145 E



GROUP 1. EQUIPMENT REQUIRED
Dental Unit, worktop, services and fittings
Type 3 & Type 3a see ad(4)001/2
Coat hook.



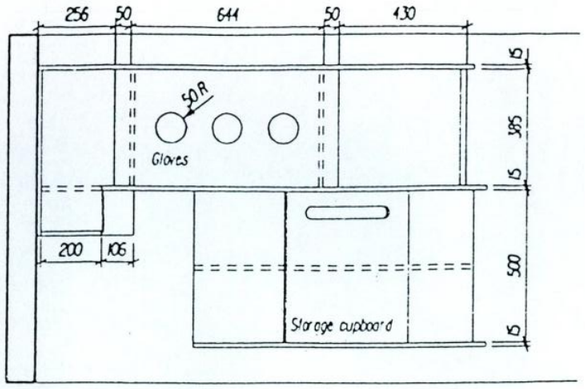
Key to cubicle layout

NOTE: For partition details see drawing Nos AA7X75/178

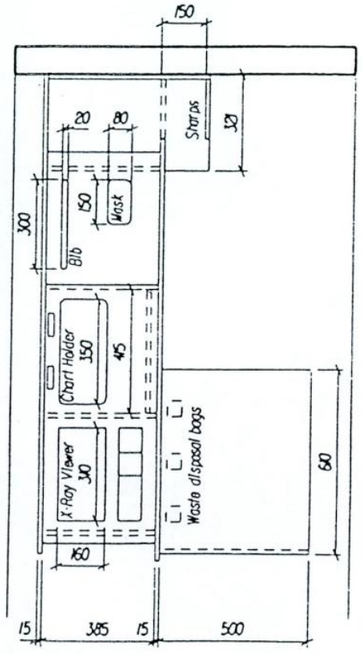
Abercrombie Duncan and Monahan
Architects
Unit 1, 7 Chalcot Road, London NW1 8LH
0171-586 3311 Fax 0171-722 8448

Dublin Dental Hospital
GROUP 1 EQUIPMENT. PHASE 2

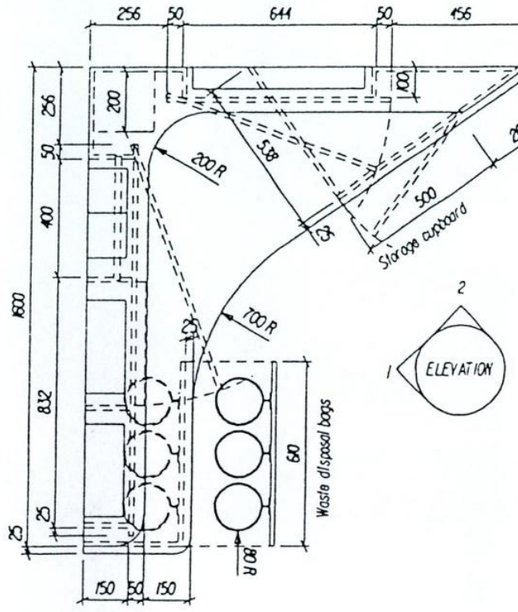
Title Cubicle Type E
Scale NTS
Drawing number 399/AL(4)1

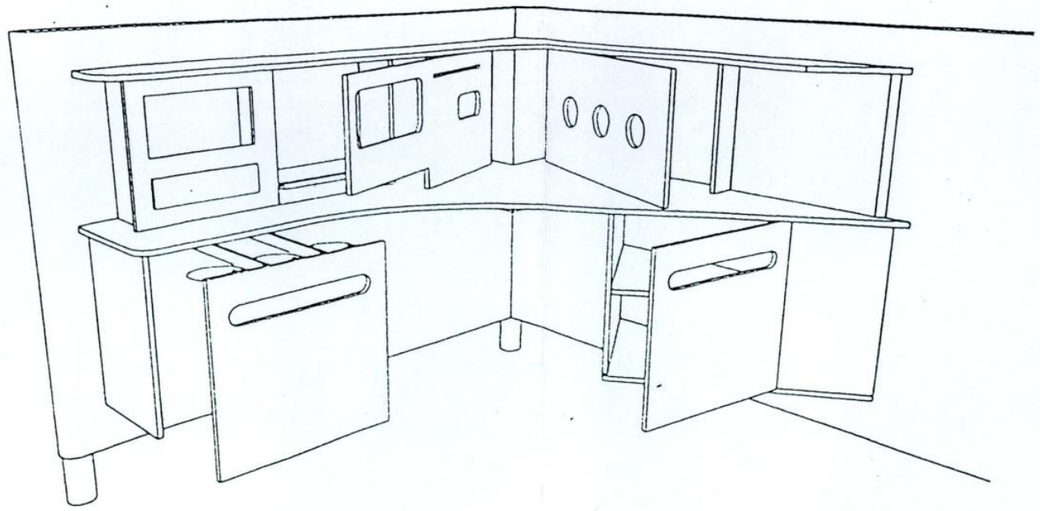


ELEVATION 2



ELEVATION 1





PERSPECTIVE VIEW

CLINICAL WORKTOP/STORAGE UNIT

Unit to be fabricated from 15mm Compact Laminate (white laminate, black core)

The fixings for the unit are to be designed in accordance with the main contractors proposed structure and method of support for the dental cubicles.

The facia panels are to have apertures cut to allow access the following: X-ray viewer, chart holder, Mask, Bib, Gloves, 1No. double plug, 1No. computer data point, 1No. dental chair cut out switch.

The Chart holder is to have an extended shelf with a 10 x 7mm continuous groove.

The Bib compartment is to have a 20mm diameter stainless steel tube, two routed grooves to support the tube in place and allow the roll of bibs to be dispenced

The waste disposal bag panel is to have three sets of stainless steel double rings to support and hold plastic bags.

The panel is to be supported on a telescopic steel frame.

The unit is to be fitted with a lower shelf to support the sharps box and a storage cupboard with 1No. adjustable internal shelf.

All movable panels are to be fitted with stainless steel piano hinges and magnetic closers.

All apertures and details are indicative and subject to final adjustment.

Ref. Date. Revisions.

Ahrends Burton and Koralek
Architects
Unit 1 7 Chalcot Road, London NW1 8LH
0171-586 3311 : Fax 0171-722 5445

Title: CLINICAL WORKTOP/ STORAGE

Scale: 1:20 Date:

DUBLIN DENTAL HOSPITAL

Drawing number: AA(4)001

... Bibliography

References

BEL GEDDES, Norman, Horizons, New York, Dover Publications., 1977.

BENTON, Tim and Charlotte, (Ed) Form and Function, History of Architecture and Design 1890-1939, London, Granda Publ, 1975.

BUSH, Donald J., The Streamlined Decade , Canada, Mc Graw-Hill Ryerson,

COLLINS, Michael, Towards Post Modernism, Design Since 1851, London, British Museum Publ, 1987.

CORNISH, Eric H., Materials and the Designer, Cambridge,University Press, 1987.

DORMER Peter, Design Since 1945, London, Thames and Hudson, 1987.

DORMER, Peter, The Meaning of Modern Design, London, Thames and Hudson, 1990.

DORMER, Peter, The new furniture, London ,Thames and Hudson.

DREXLER, Eric k., Engines of Creation, London, Fourth Estate, 1990.

EDWARDS, Clive D, Twentieth Century Furniture- Materials, Manufacturing and Markets, U.K., Manchester Press, 1994.

EIDELBERG, Martin, Design 1935-1965 What Modern Design Was, New York, H.N. Abrams, 1991.

FIELL, Peter and Charlotte, Modern Furniture Classics- Since 1945,London, Thames and Hudson, 1991.

FIELL, Peter and Charlotte, Modern Chairs, Hohenzollernring Germany, Taschen, 1993.

GARNER, Philippe, Twentieth Century Furniture, Oxford, Phaidon Press, 1980.

ICA, (Institute of Contemporary Arts) The Modern Chair, London, ICA, 1988.

KATZ, Sylvia, Plastics Design and Materials, London,Studio Vista, 1978.

KATZ, Sylvia, Plastics, Common Objects, Classic Designs, London, Thames and Hudson, 1994.

KINSMAN, Rodney, The Logical Art of Furniture, London, Forth Estate, 1992.

LUEDER and NORO, (Ed) Hard Facts About Soft Machines - The Ergonomics of Seating, London, Taylor and Francis, 1994.

NELSON, George The design of Modern Design, London, M.I.T. press, 1994.

NOBLET, Jocelyn de, (Ed) Industrial Design -Reflection of a Century, Paris, Flammarion, 1993.

RADICE, Barbara, Memphis, London, Thames and Hudson, 1986.

RING, Malvin E., Dentistry, Illustrated History, New York, Harry N. Abrams Publishers,1985.

SCHIEFER, Herwin, The Roots Of Modern Design, London,Studio Vista, 1970.

SPARKE, Penny, An Introduction to Design and Culture in the Twentieth Century, London, Allen and Unwin Hyman, !986.

SPARKE, Penny, Furniture, Twentieth Century Design, London, Bell Hyman, 1986.

Journals

Image Interiors, Irish Dental Probe, Industrial Design, Domus, Wired.

Internet Sights

http://athos.rutgers.edu:80/nanitech/.

http://www.halcyon.com/nanojbl/.

Interviews

Mr D. Clarke, general engineer in the Dublin Dental Hospital- 10/10/1996, 3/12/1996, 11/1/1997 and 14/1/1997.

Mr P. de Freine, A.B.K. Architects- 15/1/1997, 16/1/1997 and 18/1/1997.

Prof. D. B Shanley, T.C.D.- 28/11/1996.

Mr M. Daly, Henry Schein Ltd.- 23/1/1997.

Mr D. O' Faherty, Siemens Medical Division- 15/1/1997.

Dr B. Harrington, D.D.H- 17/1/1996.

Mr Jari- Pekka Teravainen, Planmeca, Helsinki- 12/1/1997 and 17/1/1997 (phone interview).

Promotiomal Literature

Planmeca brochures 1996.

Other Sources

Dublin Dental Hospital- Library, Technical Staff, and Doctors;

The Dublin Dental School- Trinity College;

Planmeca Dental Company- Finland;

Moris Dental- Dublin;

Staff in North Western Health Board;

The Irish Business Library-Dublin;

Trinity College Libraries;

N.C.A.D. Library;

U.C.D. Architectural Library;

Mc Cormac Dental Supplies Dublin;

Harvard Dental School Library and Museum and a host of dentists around the World.