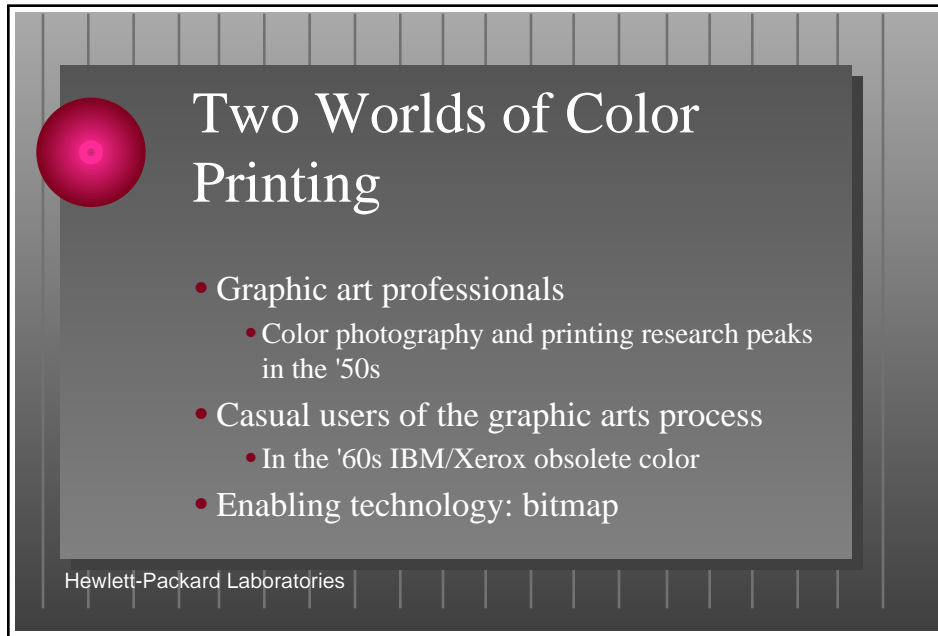


Digital Color Printing 1995: A Retrospective from the Trenches



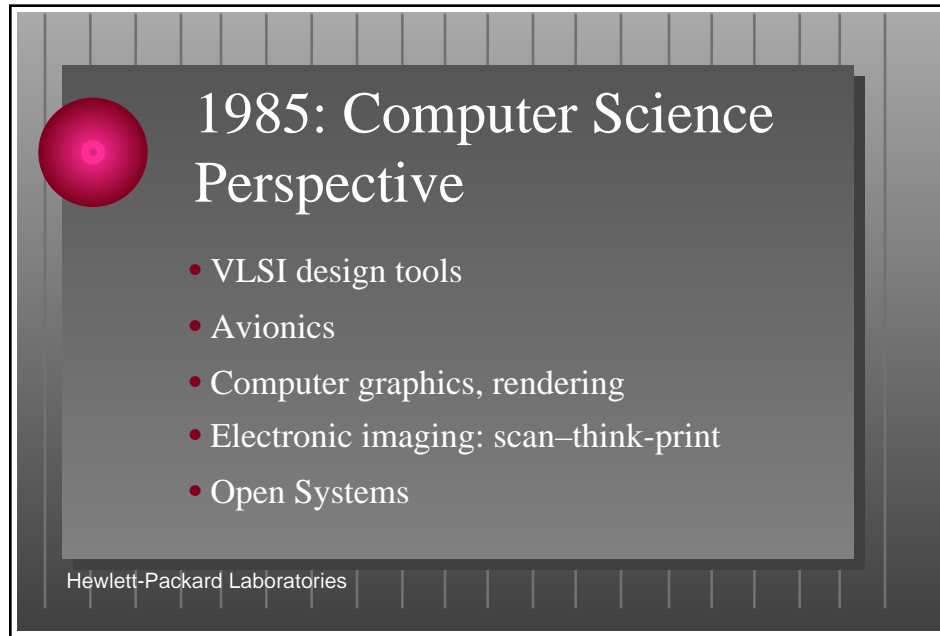
Two Worlds of Color Printing

- Graphic art professionals
 - Color photography and printing research peaks in the '50s
- Casual users of the graphic arts process
 - In the '60s IBM/Xerox obsolete color
- Enabling technology: bitmap

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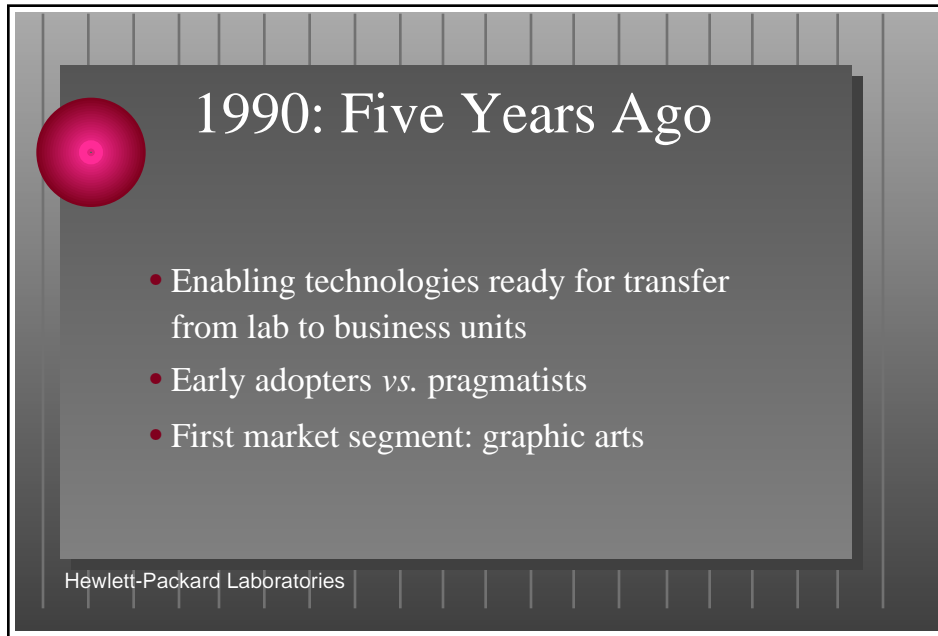
Two Worlds of Color Printing

- In the 50s the color science for photography was developed
 - After that the emphasis moved to the chemistry
- Color offset and gravure are given a scientific foundation at the same time
 - Yule, Rhodes
- Typewriters had a bicolored ribbon: red and black. Red was for emphasis and negative numbers
 - IBM Selectric came only with monochrome ribbon
- Very short in-house runs were produced with mimeographs. Easily use color by writing on matrices of different colors
 - Xerox replaced the short in-house market and came only in black and white




1985: Computer Science Perspective

- We will focus on the casual user
- The first to attack the problem were computer scientists and electrical engineers in the research lab, because they had bitmap computers
- Next slides:
 - Stripper (Retouschierer)
 - Studio
 - Roland console
 - Roland port controls
 - Versatec plotting VLSI
 - VLSI cell
 - VLSI book
 - Cromalin station
 - Mik checking color
 - Mik loading car
 - Mik delivering stripped forms
 - Office at PARC



1990: Five Years Ago

- In the last slide we saw a computer scientist's office in 1989
- All equipment is commercial:
 - Calibrated Barco monitor
 - SparcStation
 - Gretag spectrophotometer
 - D50 fluorescents in the ceiling fixtures
- Graphic arts: Adobe Photoshop, Adobe Separator, Adobe Illustrator, Aldus PageMaker, Aldus Persuasion



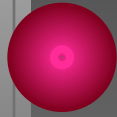
Typical Research W/S

	1985	1990	1995
System	Dorado or VAX	SparcStation 1+	486 DX2/66
CPU Power in MIPS	1	15	33
Main / Disk Memory in Mbytes	16 / 315	24 / 207	16 / 500
Display depth in bits	24 @ low res.	8 @ high res.	8 or 16 @ high res.
Operating system	proprietary	Unix	Windows
Price in \$	50,000	15,000	2500

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Typical Research W/S

- There has been only one change in workstations over the past ten years
 - CPU performance has increased but was eaten by X-Windows on Unix and Visual Basic on Windows
 - Optimization went from micro-coding to portability to fast delivery of upgrades
 - Memory prices have not changed much, but disk prices dropped like a rock this summer
 - Operating systems are now bought at the checkout stand of supermarkets
- Prices have dropped dramatically
 - In '85 only top scientists had Dorados or personal Vaxen
 - By '90 engineers have powerful workstations
 - Today people have more powerful machines at home than at work
 - Most Pentium based PC are sold in the SOHO market
 - Windows 95 was marketed to home users



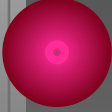
New Strategies in 1990

- Pragmatists vs. early adopters: Color for the masses
- In house color production by casual users
- Market success is driven more by price than features
- Prerequisites:
 - Image quality – Industry standards – Open Systems

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New Strategies in 1990

- Radical changes in business strategies
- Office automation failed to deliver productivity improvements
- By 1990 we pay the interest for the debt accumulated during the 80s
- Emphasis on productivity and cost cutting
- Low cost does not mean cheap: the quality has still to be there
- Price for quality color dropped to under \$2000



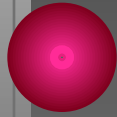
1995: Status and Outlook

- PhotoCD bundled with SOHO printers
- Casio digital camera QV-10
- Challenge of disposable cameras
- Quality: need tools to enable the non-skilled to improve visual quality of poor images

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1995: Status and Outlook

- Quality color printers are \$500
- Kodak is revamping the marketing effort for PhotoCD in the SOHO market
- Casio specializes in mature markets
- If Casio has a digital camera it means that pragmatists will buy it
- Casio's camera is over \$500
- For \$12 you can buy a disposable camera and for 20 cents a piece you get a good quality print from the drug store at the corner
- Even if Photoshop would drop to \$19.95, it is not a product for casual users.
Example: it does even not have help



Addendum: New Color Difference Formula

The CIE has published CIE94:

CIE 1994 (L^* C_{ab}^* H_{ab}^*)
colour-difference model

for industrial color-difference evaluation

Use CIE94 instead of the old CIELAB
formula

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Addendum: New Color Difference Formula



 **Historic Video Footage**

- Some of the footage was released only in February 1995
- Not shown: most of the work went into color printing
- Thank you to
 - Maureen Stone, Xerox PARC
 - Mik Lamming, Rank Xerox

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Historic Video Footage

- The work shown was mostly accomplished in 1987–1988