LABORATORIO DI VISIONE ARTIFICIALE
Tel. 0382/391372 Telefax 0382/412881

Tecniche e Strumenti per l'Elaborazione di Immagini ed il Riconoscimento di Forme

Parte I: Livello Basso e Intermedio

1. 9 ottobre 1989
c/o SPERONI Spa, Spessa Po

V. Cantoni:

Il segnale immagine: problemi di acquisizione, campionamento, quantizzazione, memorizzazione, e presentazione. I livelli basso, intermedio ed alto dei sistemi di visione.

Dipartimento di Informatica e Sistemistica, Università degli Studi di Pavia

DIGITIZING AN IMAGE

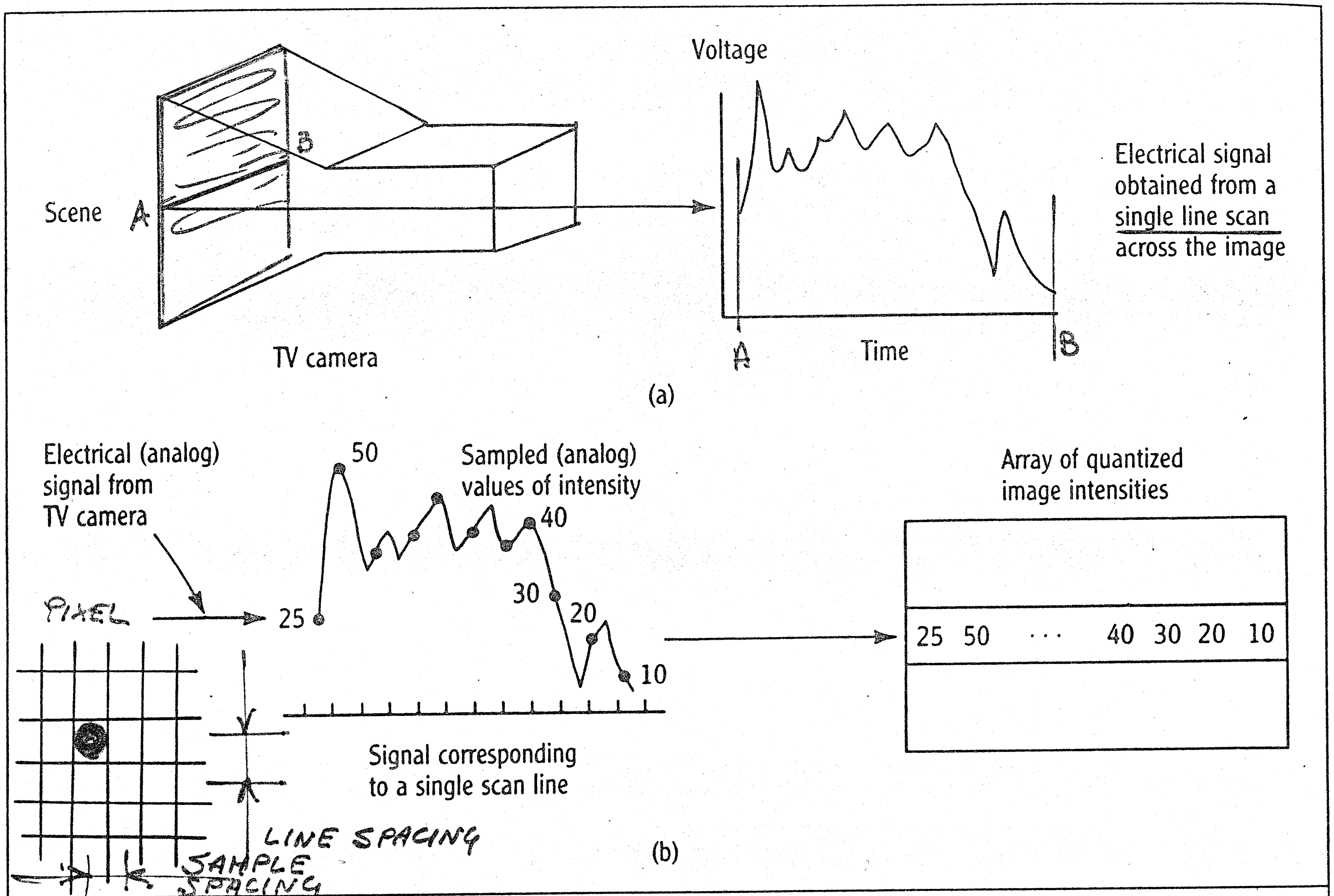
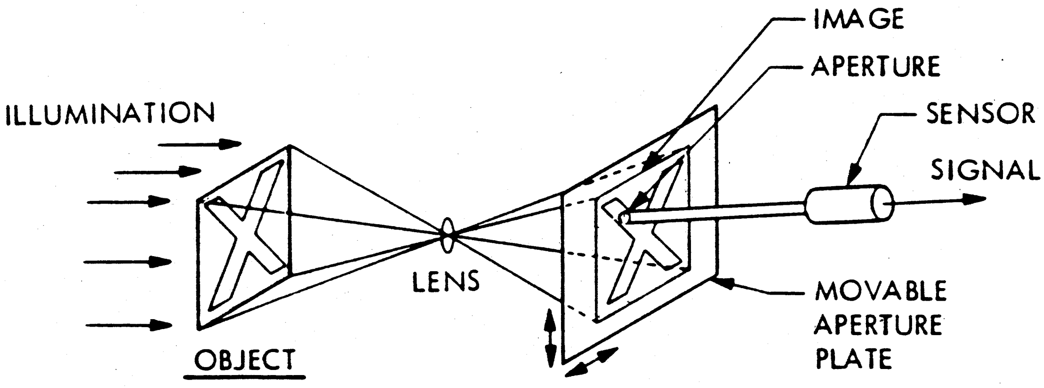


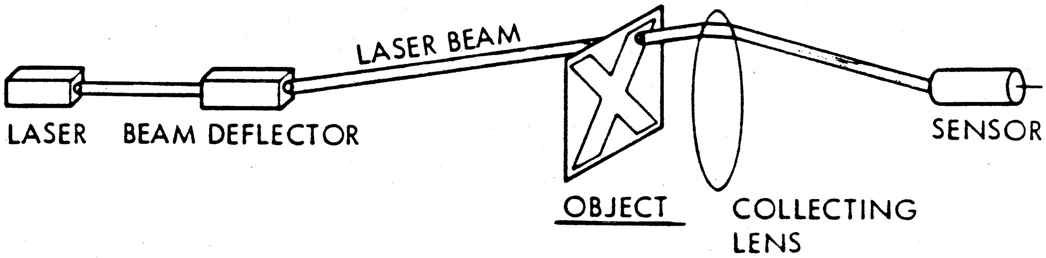
FIGURE 9-3
The Image Acquisition Process: Representing a Scene by an Electrical Signal and Then an Array of Numbers.

(a) Obtaining an electrical signal corresponding to intensities from a scene. (b) Converting an analog signal to sampled and quantized intensity values.

DIGITIZER TYPES

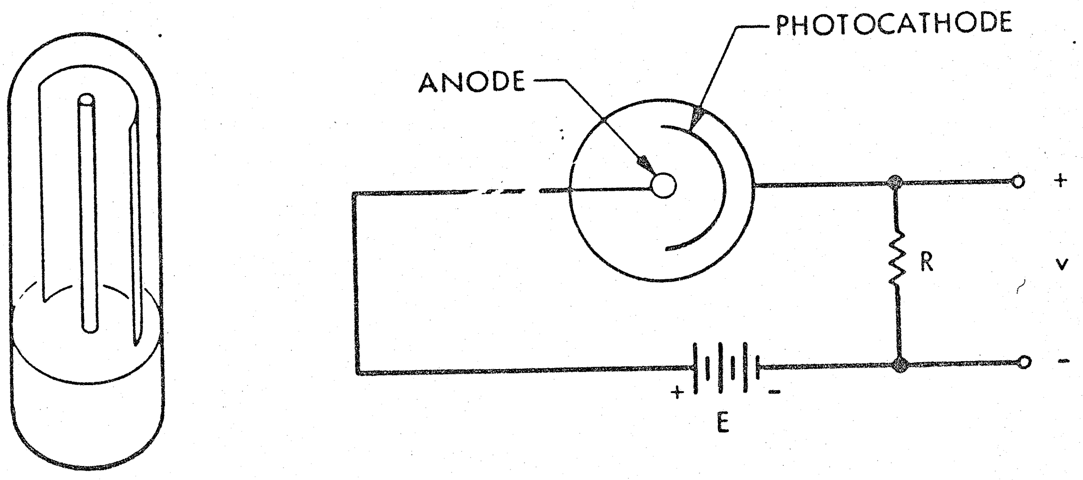


A scan-out digitizer

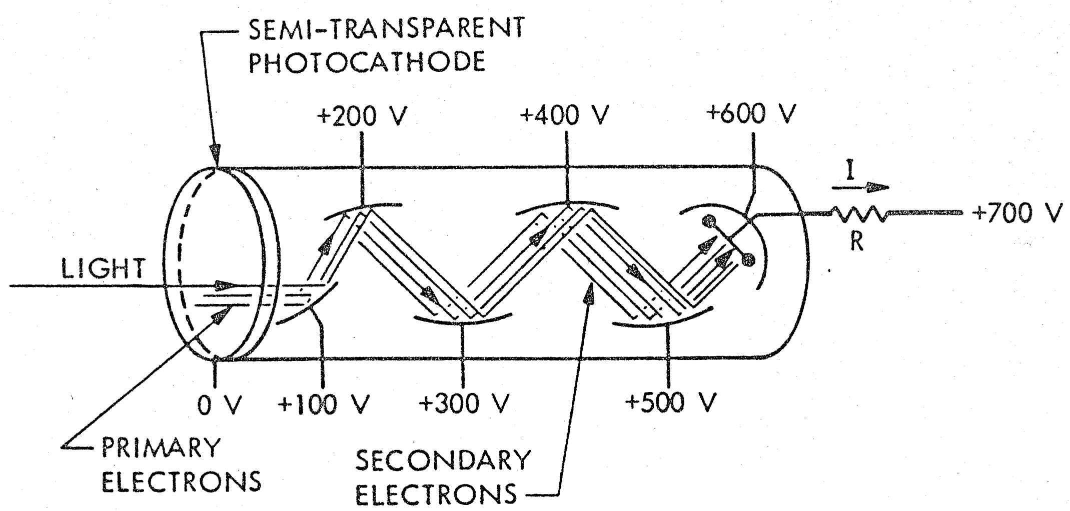


A scan-in digitizer

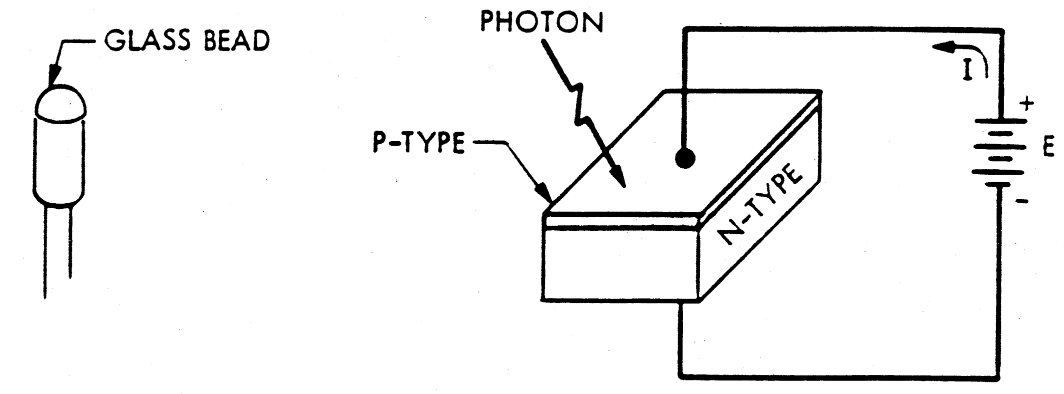
PHOTOEMISSIVE DEVICES



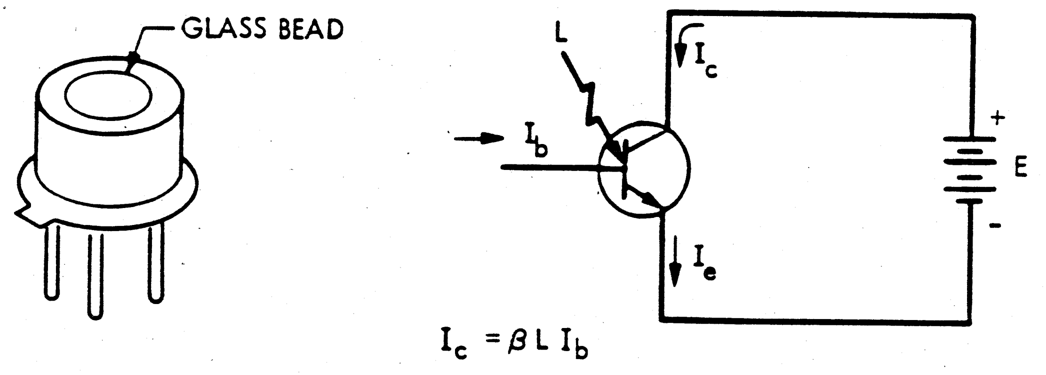
The phototube



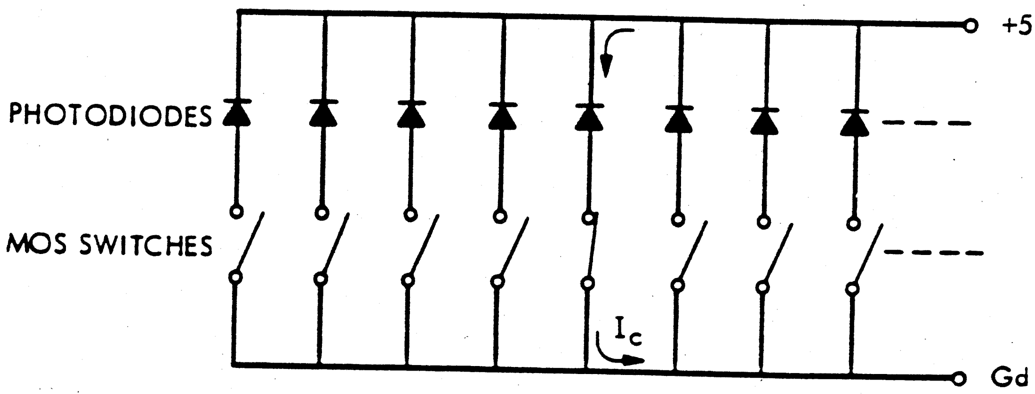
The photomultiplier tube



The photodiode

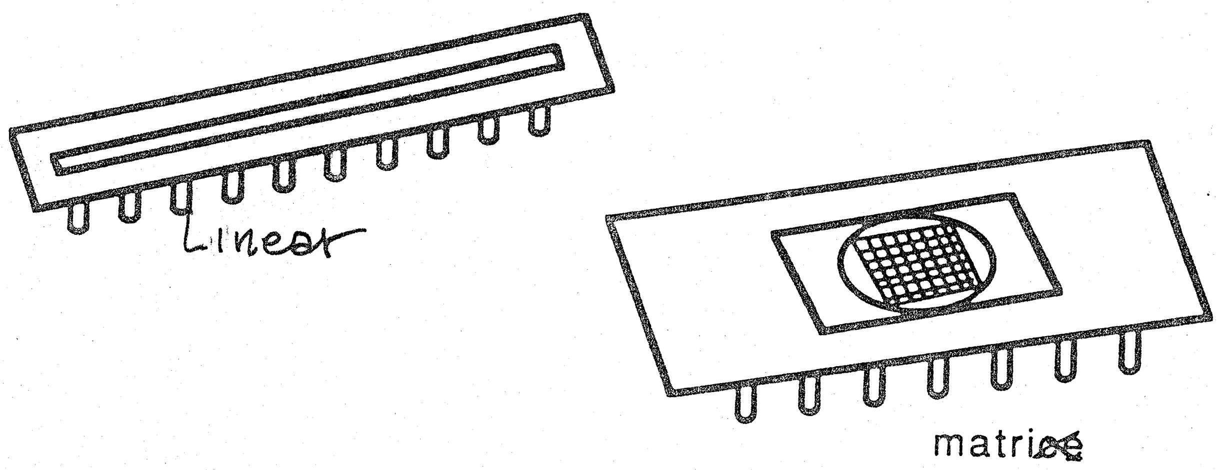


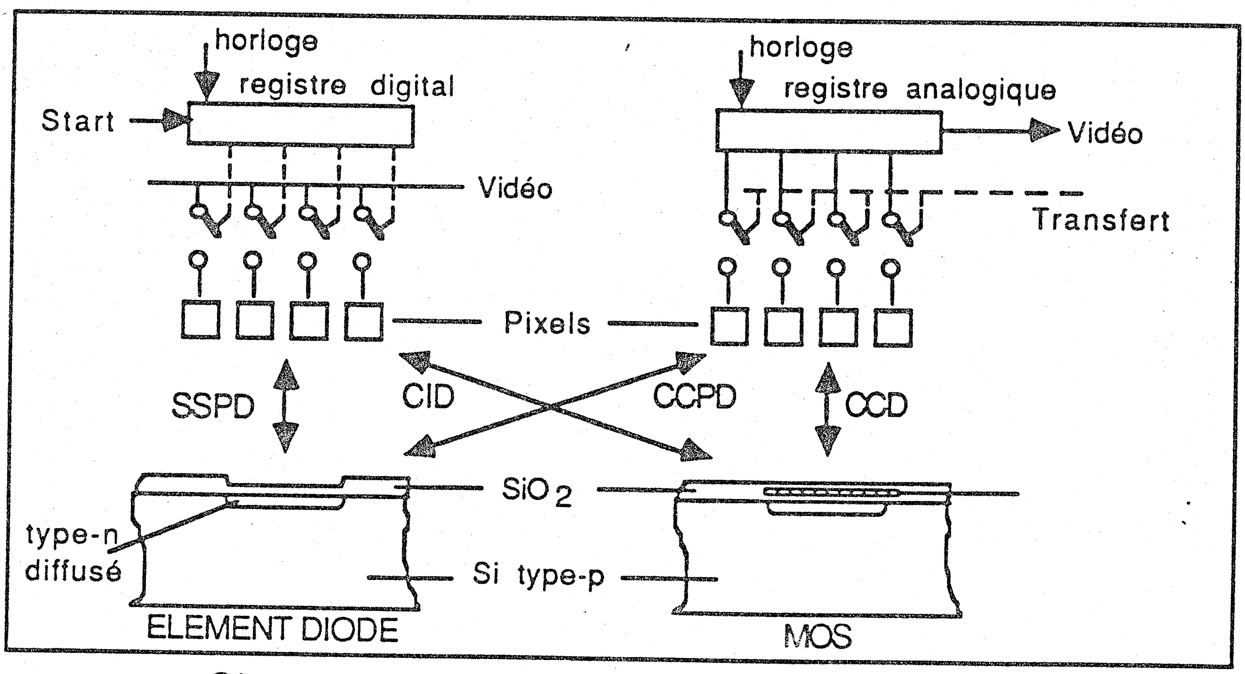
The phototransistor



The self-scanning photodiode array

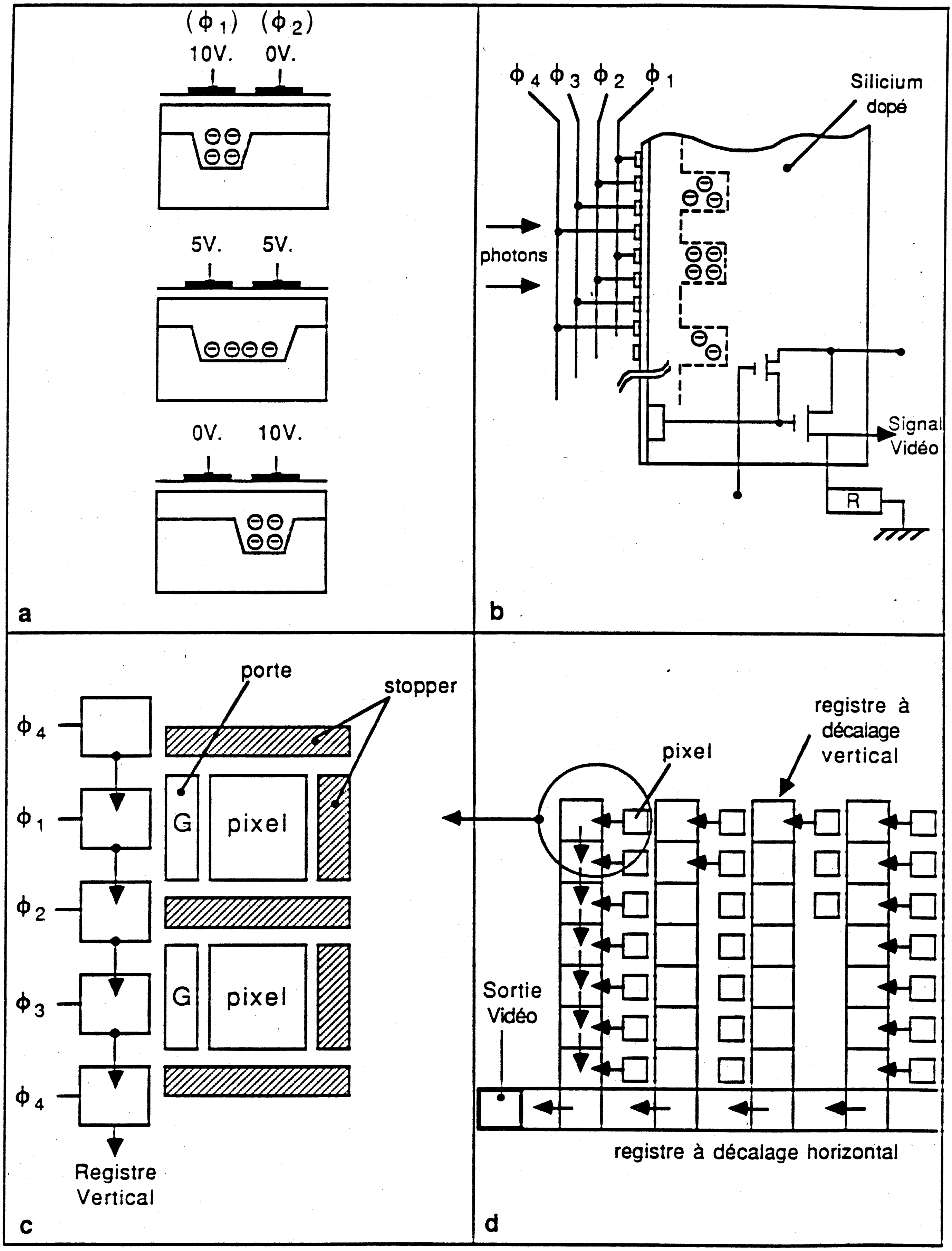
- C.C.Ds : CHARGE-COUPLED DEVICES
- C.I.Ds : CHARGE INJECTED DEVICES
- C.C.P.D : CHARGE COUPLED PHOTO DIODES
- SSPD : SELF SCANNED PHOTO-DIODES





Classement des différents RTC.

CHARGE COUPLED DEVICES



a- Transfert de charge à 2 phases ϕ_1 et ϕ_2 : exemple simplifié.

b- Coupe d'un registre de transfert

PHOTODETECTORS

- Table de comparaison des capteurs optiques en semiconducteur -

		CCD	SSPD	CID
Dimensions de cellule	matrice	15 x 15 (µm)		
	barrette	7 x 7		
Nombre de cellules	matrice	440.000	4096	100.000
	barrette	2 x 2048	2 x 2048	
Dimensions du capteur		10 x 9 (mm) 8.8 x 6.6 utiles	8 x 8	10 x 8
Bruit		très faible	plus important que CCD	
Lecture de charge		rapide	lente	non destructive
Perte de charge		oui	faible	faible
Résolution	matrice	bonne	pauvre	bonne
	barrette	excellente		
Courant résiduel		élevé	plus faible que CCD	
Tendance au blooming		oui; écran de protection prévu	faible	moins forte que CCD
DSNU		peut être fort; corrigé par ROM		peu de points blancs lumineux
Couleur		oui	non	non
Applications		industielles . cinéma	industrielles	industrielles

IMAGE DETECTORS

COMMERCIAL PRODUCTS

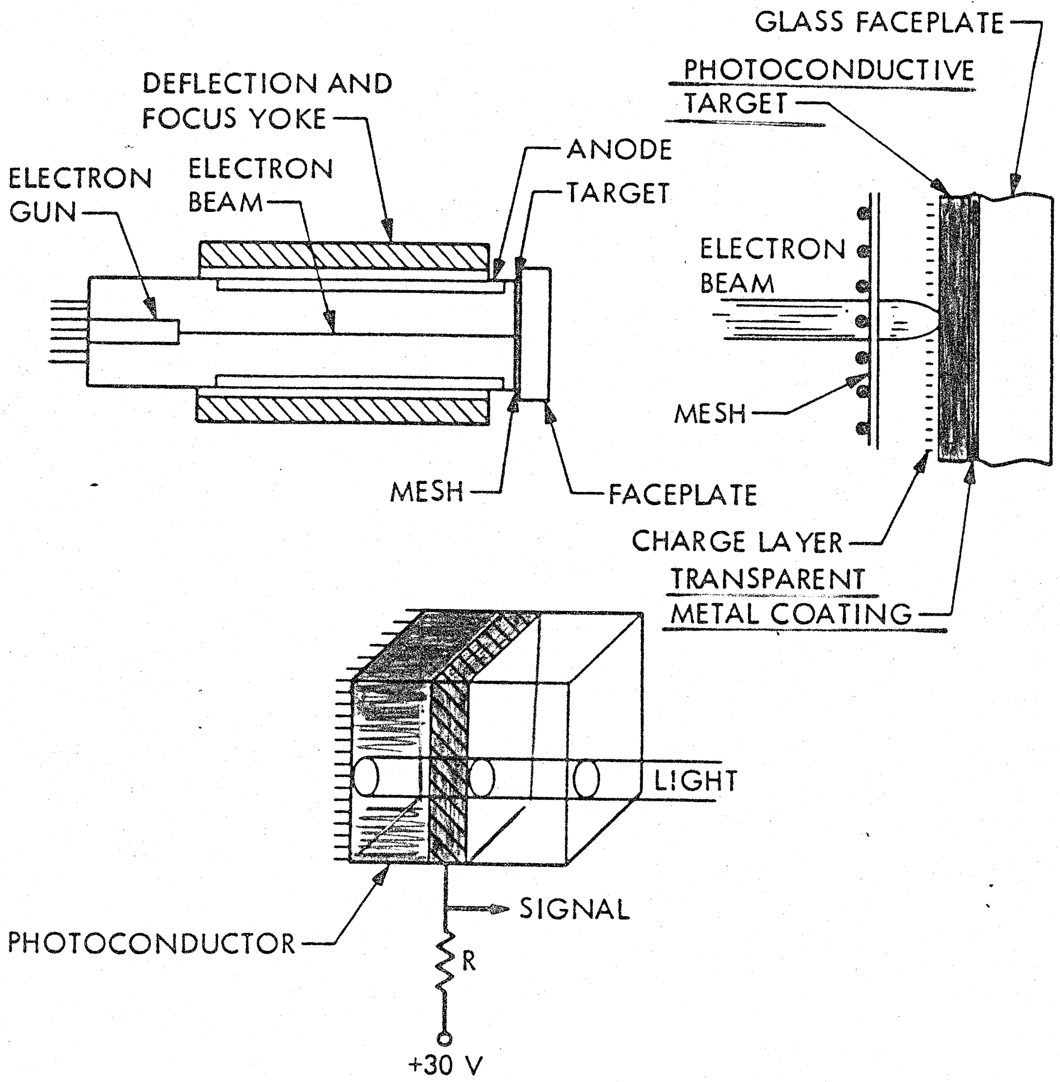
- Tableau de caractéristiques de matrices et barrettes CCD -

	Nb. d'éléments photo-sensibles	Dimension pixel (μm)	Surface sensible (mm x mm)	Résolution (lignes)	Illumination - mini (Lux) - normale	Fréquence transfert	Rati S/E (dB
SONY N-B	H = 384 V = 491	23 x 13.4	6.6 x 8.8	H = 280 V > 485	3 à F1.4 400 à F4	H = 7.16 MHz V = 15.7 kHz	46 à 50
SONY couleur	H = 510 V = 492	17 x 13	6.6 x 8.8	V = 330	30 à F1.4 2000 à F4	H = 15.62 MHz V = 50 Hz	48
	H = 756 V = 581	15 x 12	10 x 8.2	V = 330	30 à F1.4 2000 à F4	id.	
HITACHI couleur	H = 500 V = 582		6.6 x 8.8	V = 300	28 à F1.4	H = 15.7 MHZ V = 60 HZ	50
MATSUSHITA couleur	H = 574 V = 581		id.	H = 330 V = 350	10 à F1.4 100 à F1.4	H = 15.62 MHz V = 50Hz	46
N-B	H = 500 V = 582		id.	H = 380 V = 350	1.5 à F1.4 50 à F1.4	id.	50
SANYO couleur	H = 500 V = 582		id.	V = 300	21 à F1.2 150 à F1.4	H = 15 MHz V = 50Hz	46
N-B	H = 600 V = 590		id.	H = 420 V = 400	1.5 à F1.4 50 à F1.4	id.	50
IKEGAMI couleur	H = 500 V = 580		id.	H = 330 V = 400	10 à F1.2 1000 à F1.4	id.	47
G.E. (**CID**) N-B	H = 528 V = 524	15 x 15	7.7 x 7.7	H = 514 V = 512	0.3 *ft.* candle	id.	48
PULNIX N-B	H = 449 V = 579	15.1 x 2.3	6.4 x 4.8	H = 310 V = 420	2 à F1.4 50 à F1.4	H = 8.8 MHz	50
PHILIPS N-B	H = 600 V = 588		6 x 4.5	H = 450 V = 420	1.5 à F1.2 20 à F1.2	H = 15.6 MHz V = 50 Hz	50
THOMSON N-B	H = 208 V = 288		id.	V = 150	1 à F1.4 17 à F1.4	id.	50
NEC (barrettes) N-B	H = 4096 V = 1024	Dim;Stopper 5 x 7; 2 9 x 14; 5	Surface mm x μm 28.7 x 7 14.4 x 14	Fenêtre Spectrale (μm) 0.3 à 0.11	(mV/Lux.s) 1900 3500	(MHz) 1 à 3	50

Remarques

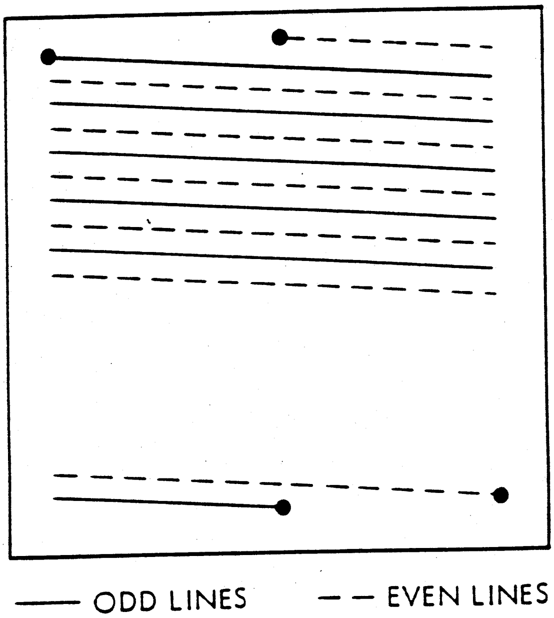
- Les matrices citées répondent au standard CCIR (625 lignes, 50 Hz).
- La liste des composants n'est pas exhaustive; il existe d'autre fabricants dans différents pays, qui offrent des produits comparables
  USA : TEXAS, RCA, EG & G-RETICON, FAIRCHILD, etc.
  JAPON : CANON, COHU, SHARP, etc.
  UK : GEC, IPL.
  RFA : SIEMENS, VALVO (Filiale de PHILIPS).
- Les matrices, de surface sensible 8.8 x 6.6 mm^2, sont équivalentes à u

9 VIDICON CAMERA TUBE



The Vidicon camera tube

STANDARD IN USA



25

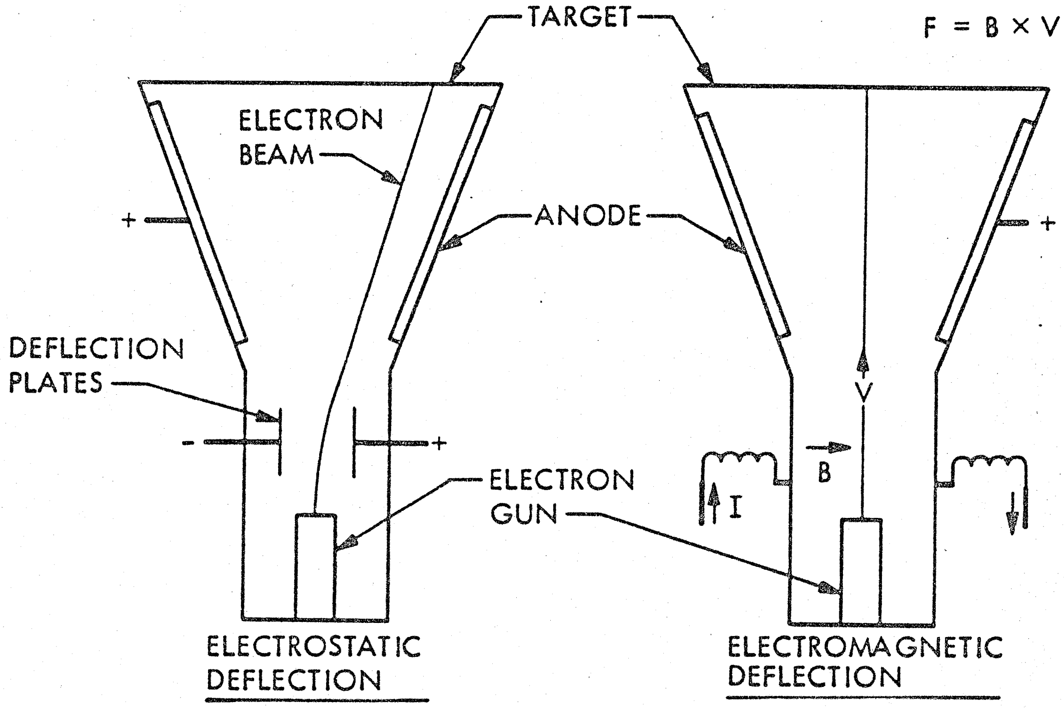
30 FRAMES/s
525 LINES/FRAME
15,750 LINES/s
63.5 μs/LINE

2 FIELDS/FRAME
262.5 LINES/FIELD
60 FIELDS/s

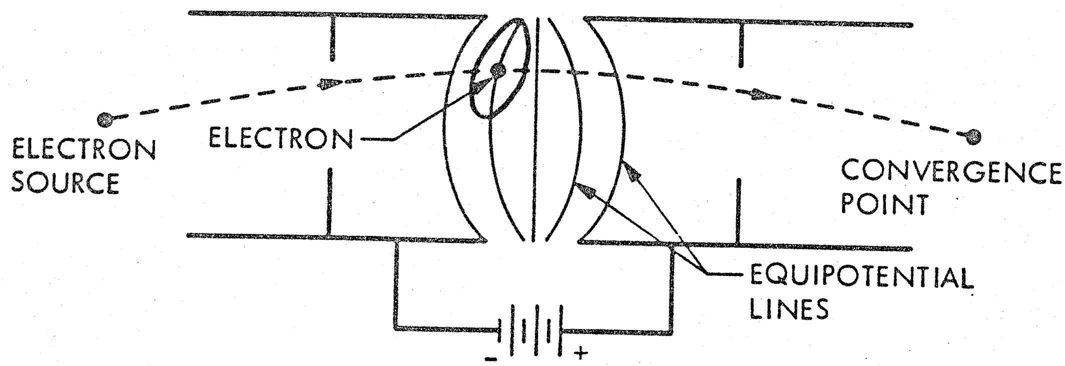
~50 μs ACTIVE/LINE
~490 ACTIVE LINES/FRAME
4.5-MHz BANDWIDTH

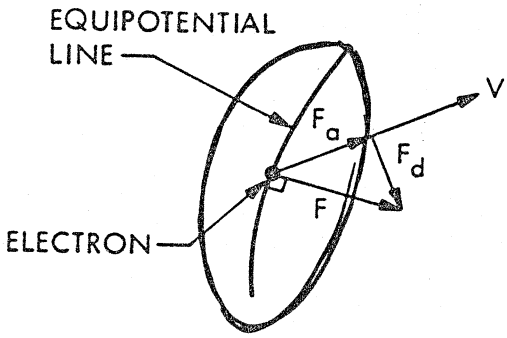
The RETMA scanning convention

7 ELECTRON BEAM SCANNING



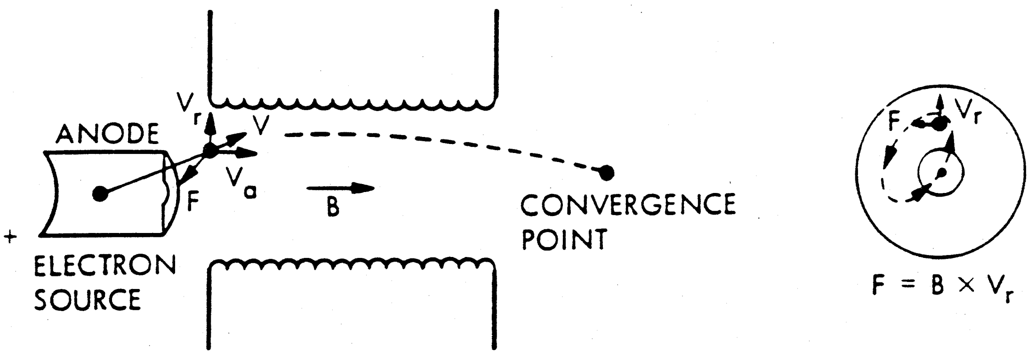
Electron beam deflection



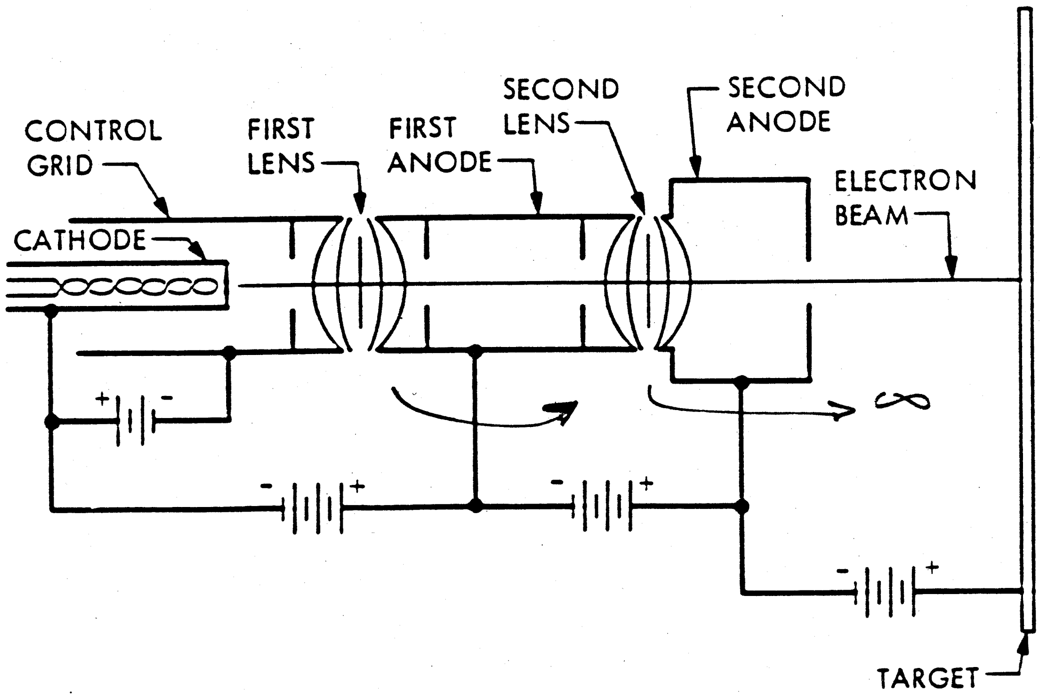


Electrostatic focus

ELECTRON BEAM SCANNING



Electromagnetic focus



Electron gun construction

IMAGE DETECTORS

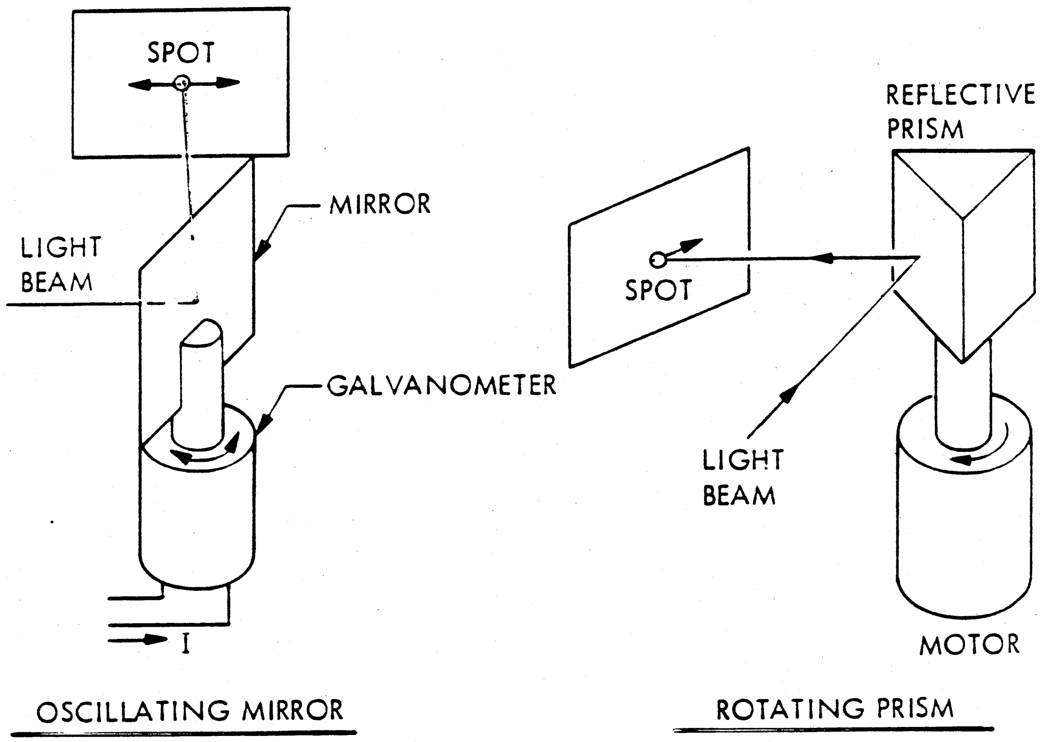
- Tableau de comparaison Tube cathodique-Matrice CCD -

	CCD	Tube (type Vidicon)
Temps de vie et fiabilité	Long; stable	Détérioration due au chauffage du faisceau électronique.
Poids et encombrement	Réduit en poids et en taille	Long à cause des bobines de déflexion et du canon à (e^-)
Rémanence	Pratiquement supprimée	Inévitable à cause de la couche photo-conductrice
Blooming (sur-éclairement)	Grande résistance, jusqu'à 100 fois la saturation	Faiblesse des tubes
Gamma	≈ 1	Plus faible (non linéarité)
Distorsion	Absence	Forte sur les coins et bords
Chauffage préalable	Aucun	Temps de mis en route de quelques 20 secondes
Consommation et Alimentation	Faible ; BT.	Grande par rapport au CCD à cause du canon et des bobines; HT nécessaire.
Usage en environnement électromagnétique	Sans effet	Influence non négligeable
Sensibilité	Jusqu'à 1,5 Lux pour F 1.4	Moins bonne
Résolution	Excellente jusqu'à 450 lignes	Excellente jusqu'à 650 lignes
Couleur	Manque de contraste	Qualité parfaite

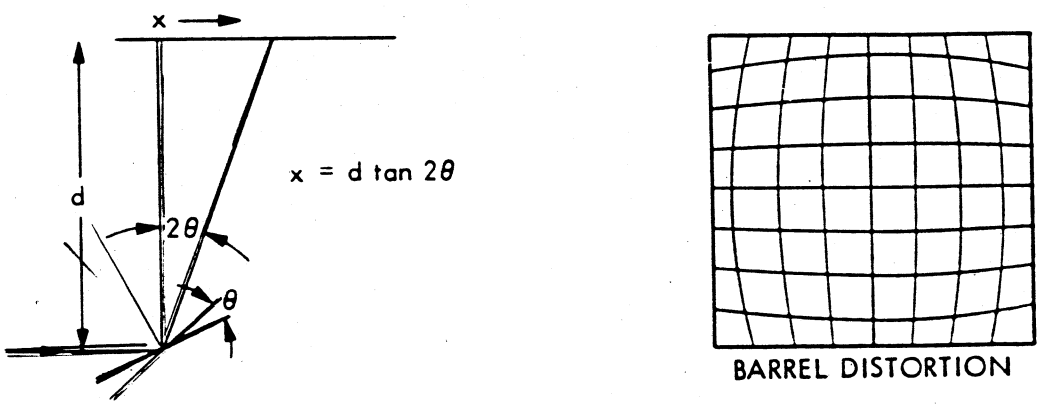
SCANNING MECHANISMS

5

MOVING MIRROR SCANNER



Moving-mirror scanning mechanisms



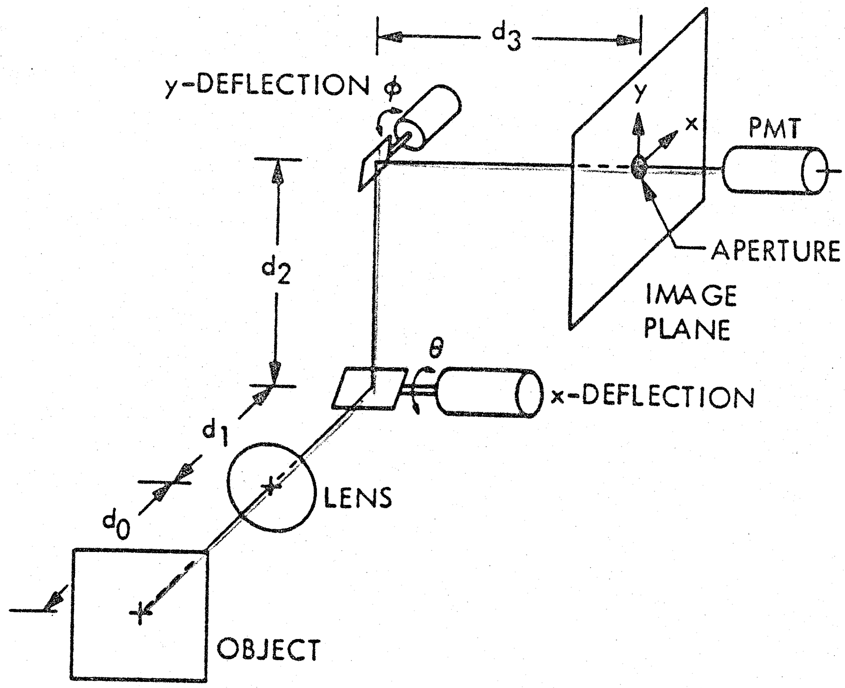
Scanning angle distortion

MOVING MIRROR SCANNER

$$\text{MAGNIFICATION: } M = \frac{d_1 + d_2 + d_3}{d_0}$$

$$x = \left[d_2 + d_3\right] \tan 2\theta$$

$$y = d_3 \tan 2\phi$$



The dual moving-mirror image plane scanner

SCANNING MECHANISMS

STEREOSCOPIC TELEMETRY

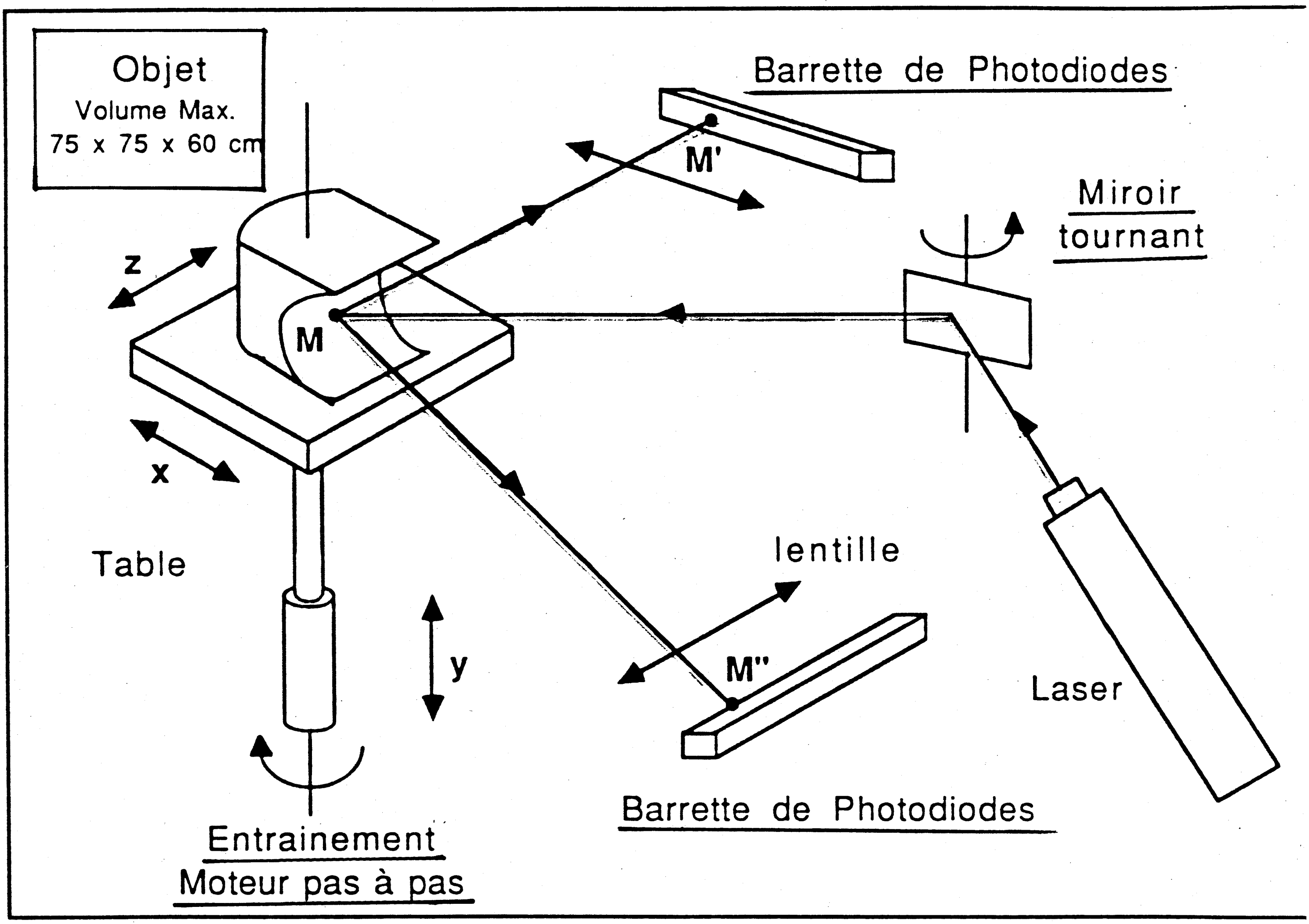


Figure 7 : Télémètre-Laser, Brevet INRIA

STEREOSCOPIC TELEMETRY

x_1, z_1 et x_2, z_2	:	centres des lentilles 1 et 2.
h_1 et h_2	:	distances lentille-barrette.
α_1 et α_2	:	angles des faisceaux réfléchis.
p_1 et p_2	:	distances algébriques des images M' et M".

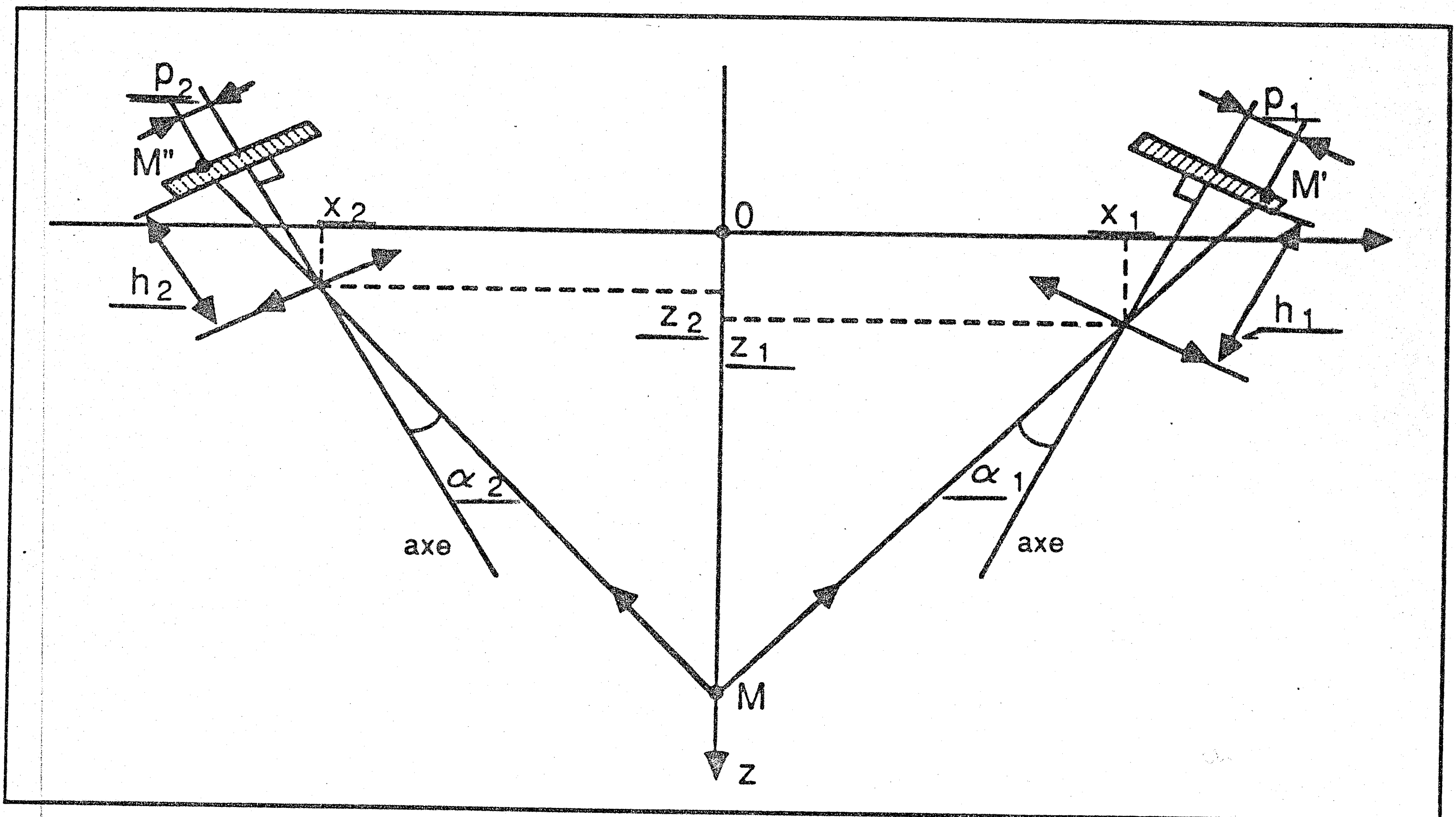
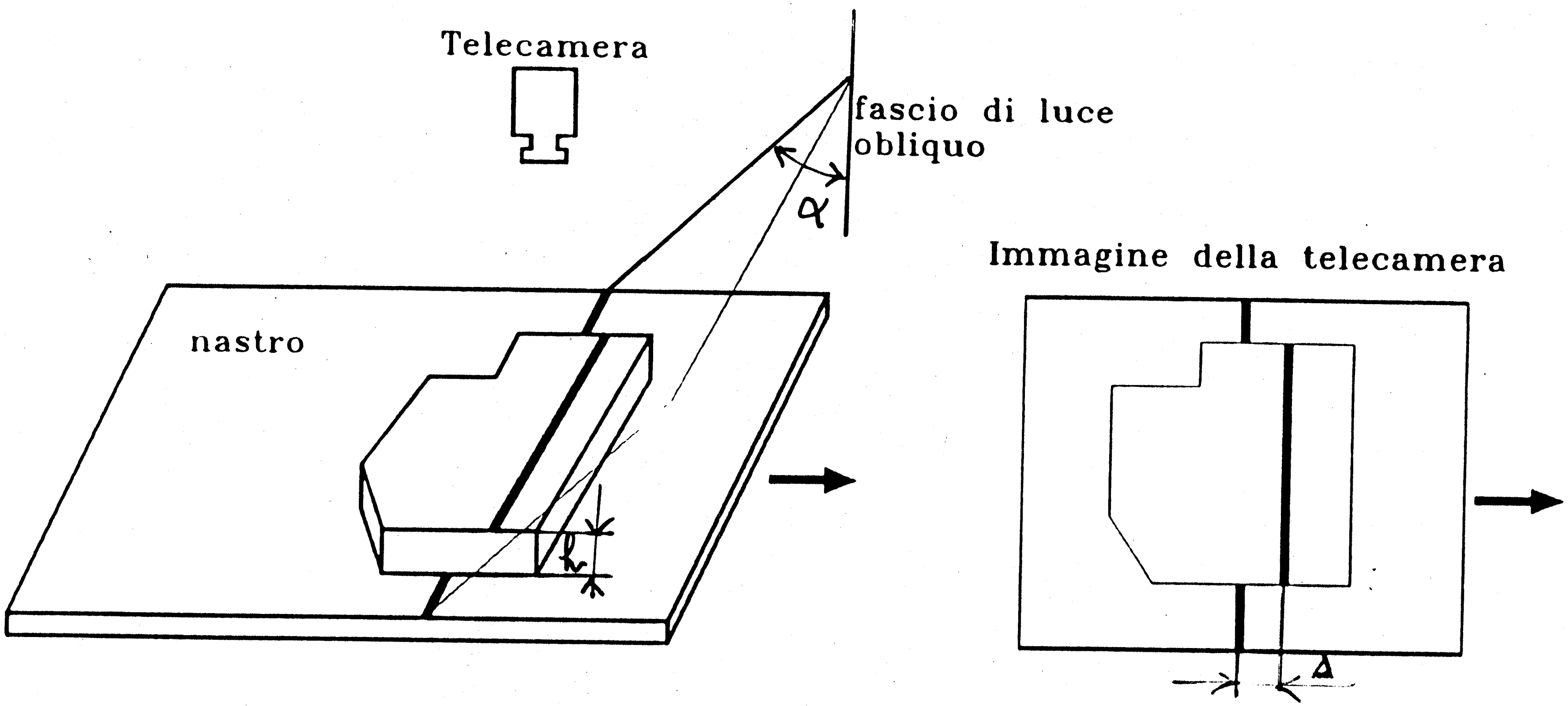


Figure 8 : Triangulation du capteur INRIA

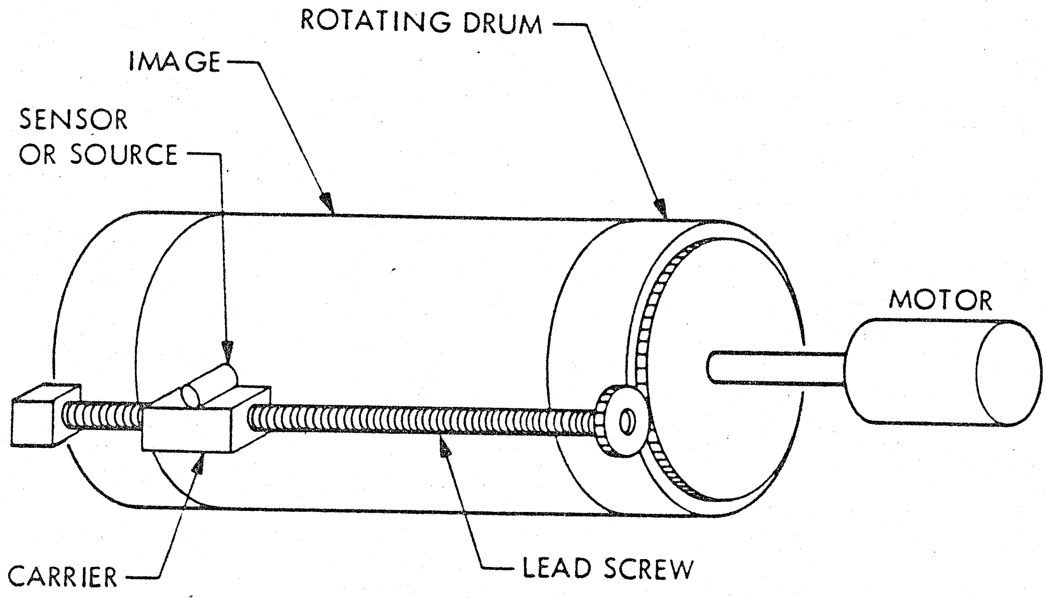
$$z_M = f\left(x_1, z_1, x_2, z_2, h_1, h_2, \alpha_1, \alpha_2, p_1, p_2\right)$$

$$h = \Delta \, tg\, \alpha$$



Acquisizione dell'immagine di un pezzo su nastro trasportatore mediante un sottile fascio di luce obliquo.

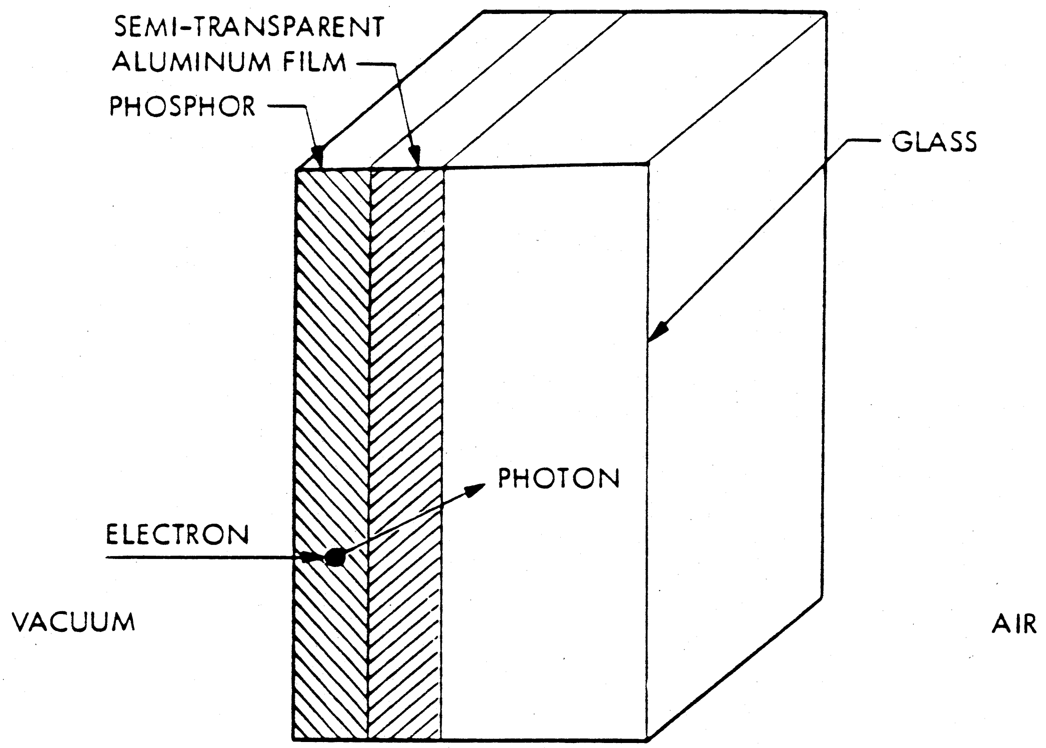
6 MECHANICAL SCANNING DEVICES



Mechanical scanning mechanisms

IMAGE PRESENTATION

CATHODE-RAY TUBE

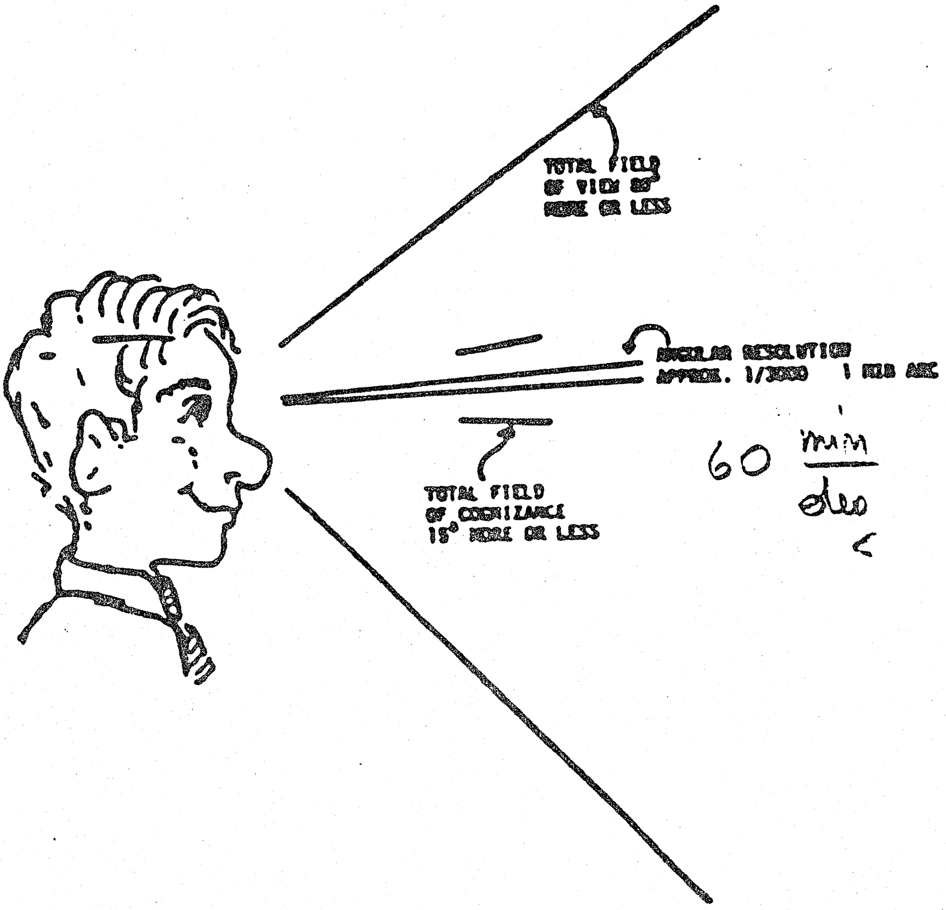


CRT target construction

30 ÷ 70 lines/mm

IMAGE PRESENTATION

VIEWING PERSPECTIVE



YAT CRITERION

YOU ARE THERE IF ALL VISIBLE OBJECTS IN THE PICTURE SUBTEND THE SAME ANGLE AS THEY DID IN REAL LIFE. YOU ARE AT THE CENTER OF PERSPECTIVE.

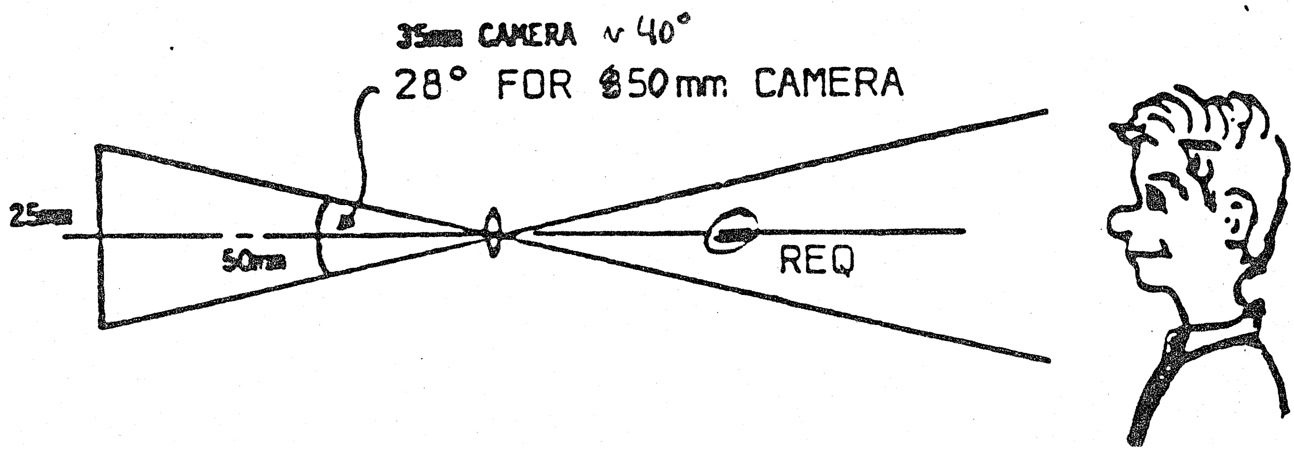
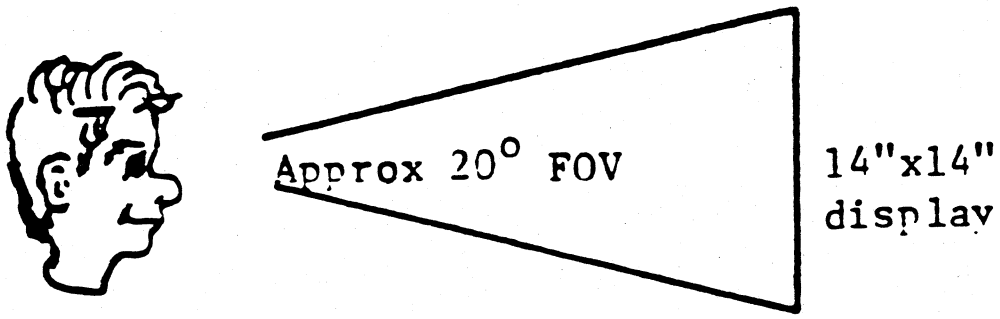
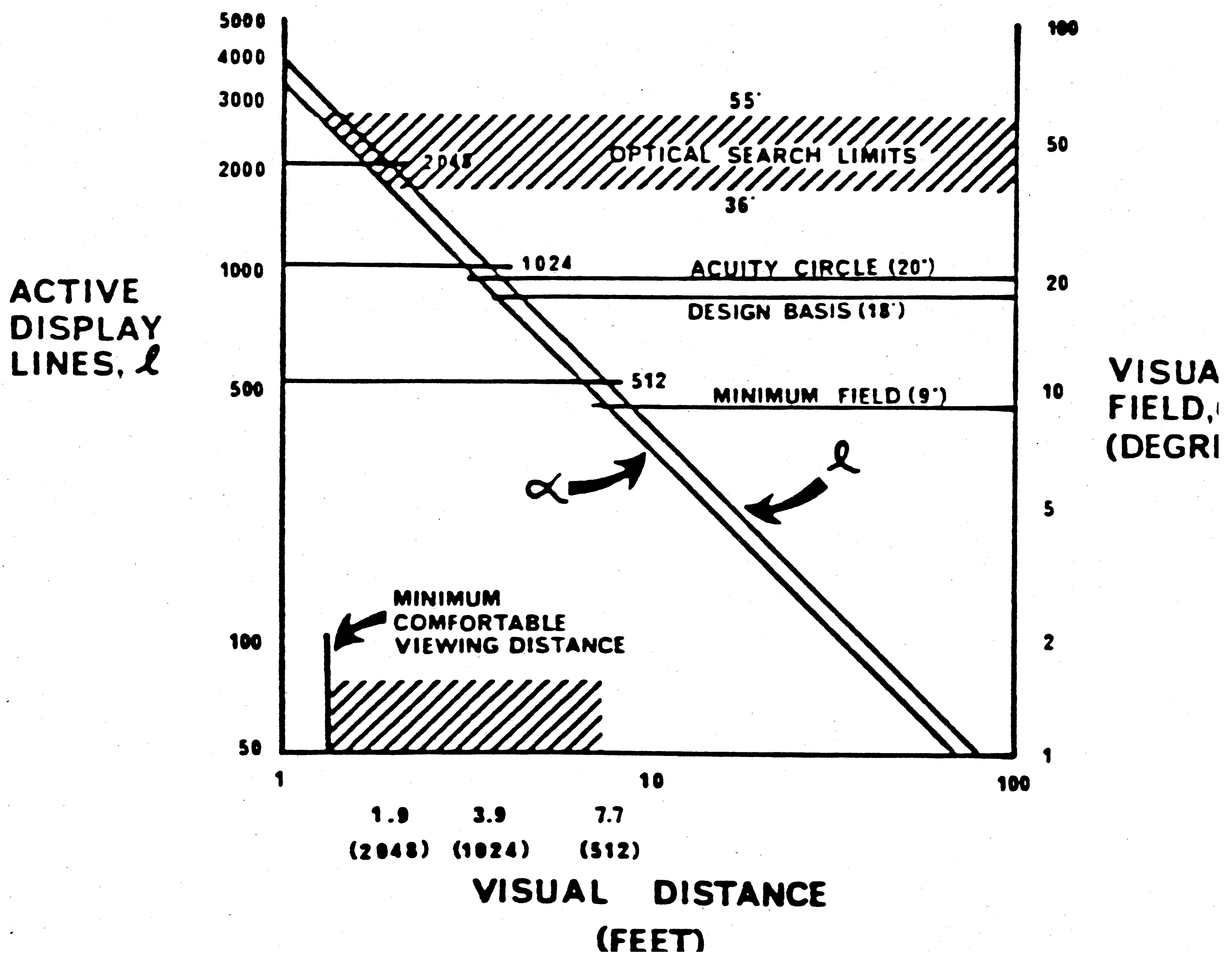


IMAGE PRESENTATION

VIEWING PERSPECTIVE





PHOTOGRAPHIC CONTROL OF PERSPECTIVE

35mm David invades Goliath country—the 35mm camera takes on the view camera's job. At left, the typical toppling architectural house of cards delivered by the minicamera. At center, the squared-off 35mm camera shows distortion elimination but too much foreground. At right, with a PC-Nikkor lens as "rising front," we see the whole thing, undistorted.

PHOTOMETHODS

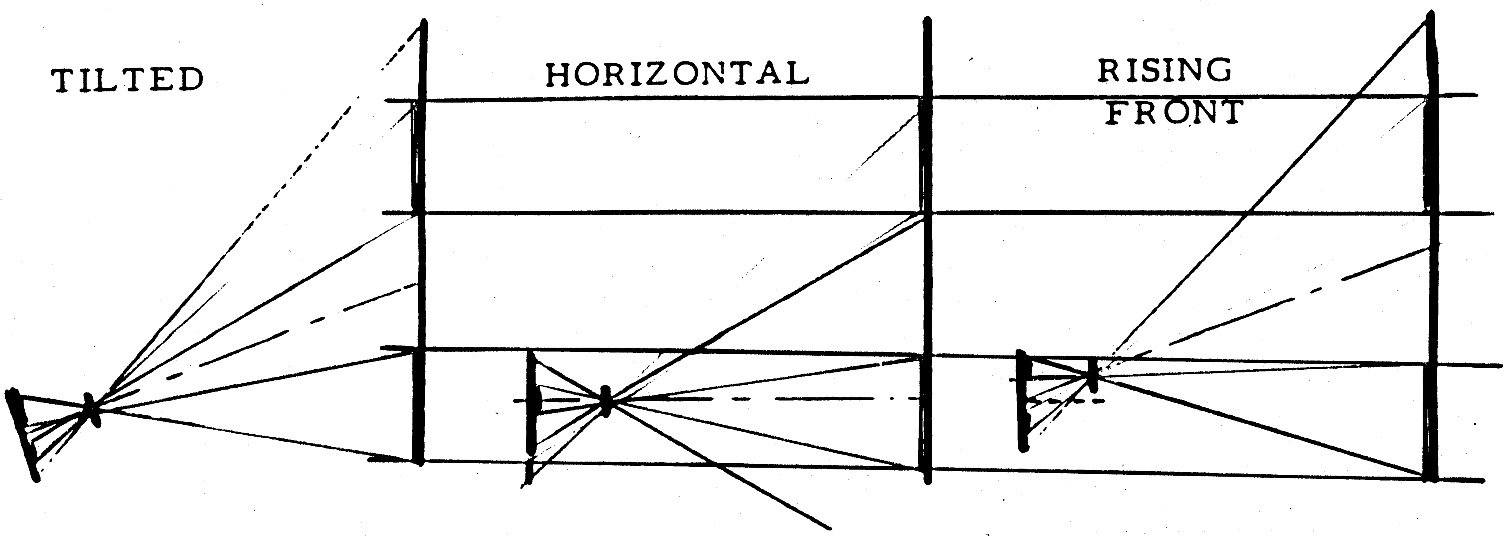
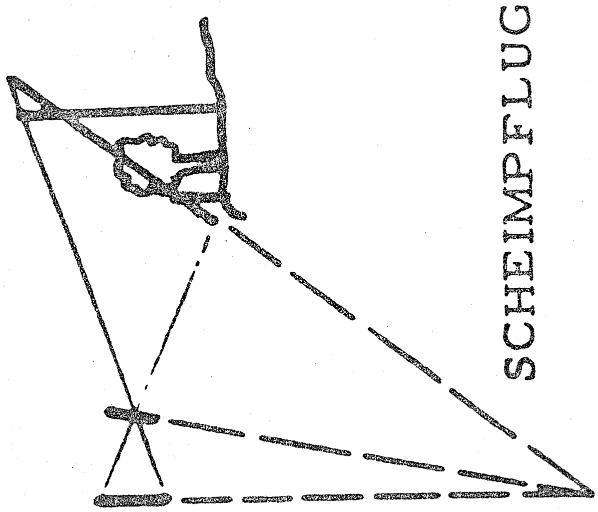
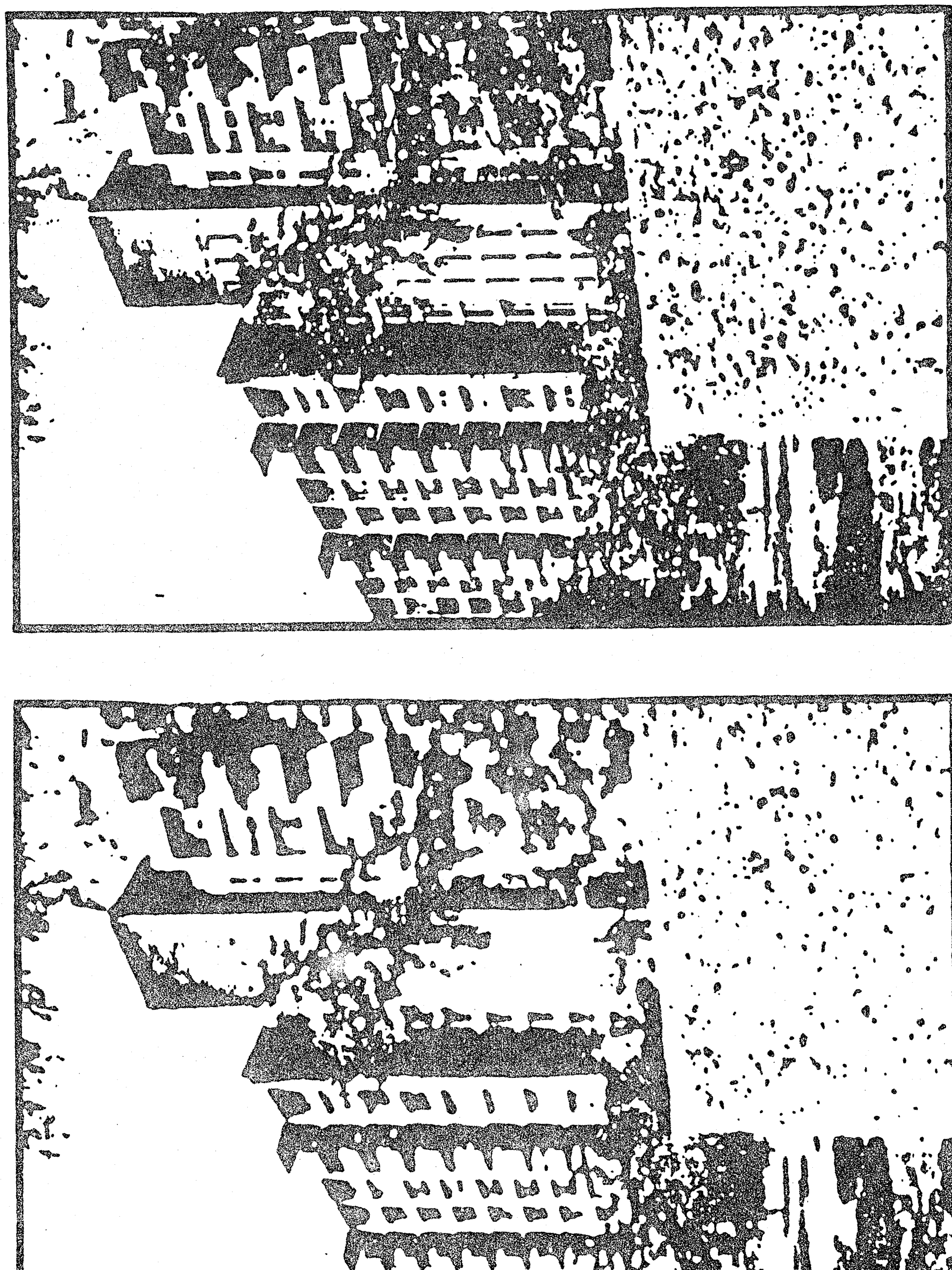


IMAGE ACQUISITION

FOCUSING METHODS



SCHEIMPFLUG

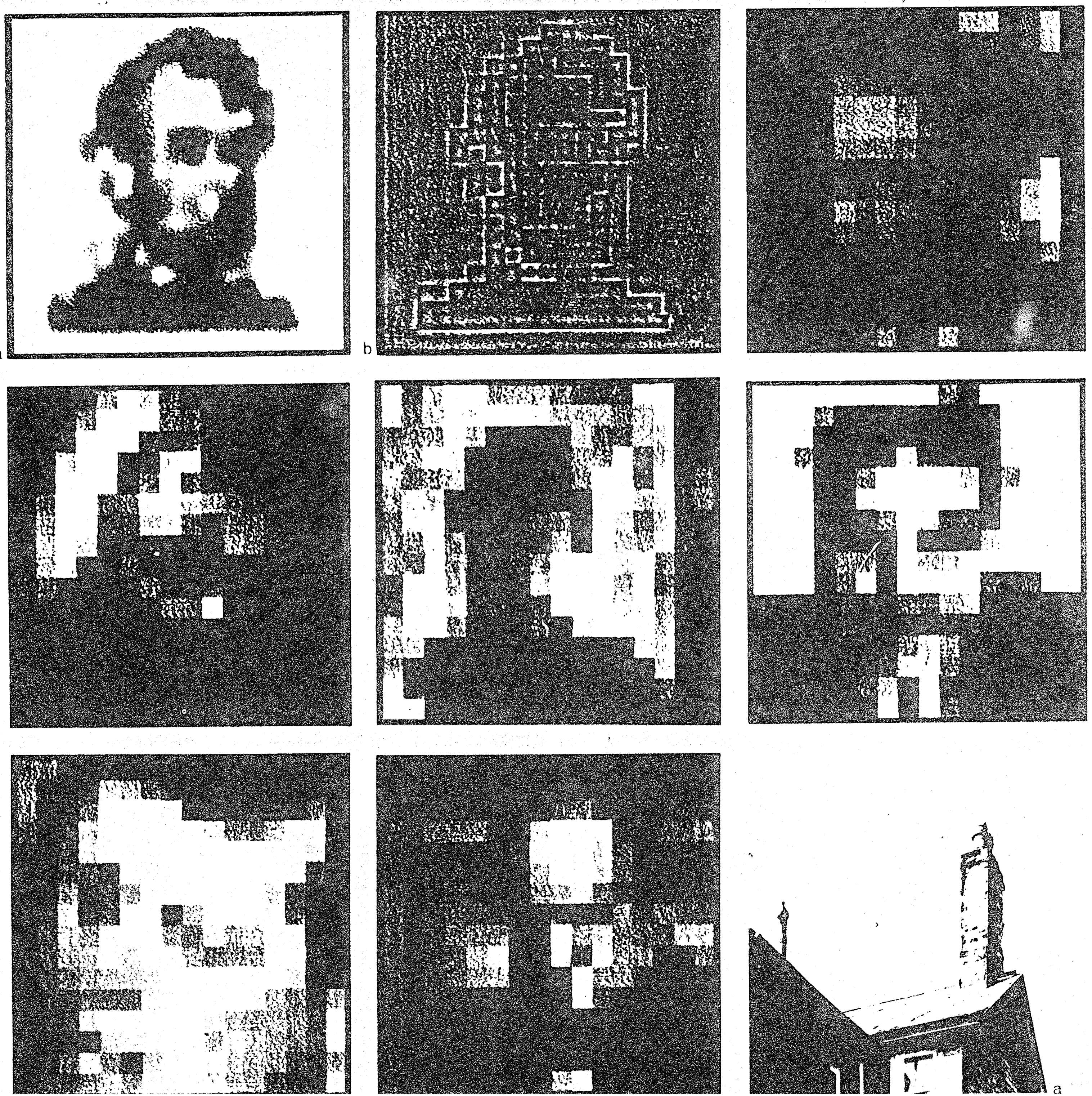


Effect of tilting the Canon TS-35 lens. At left, the wall is sharp but the building cannot be held in focus. At right, tilting the lens greatly extends the plane of sharp focus.

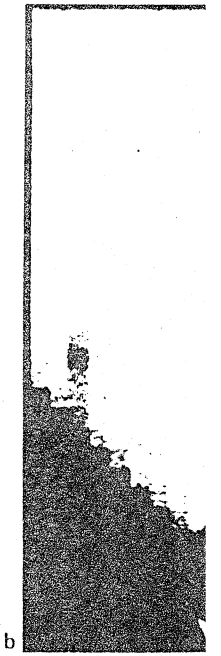
IMAGE PRESENTATION

VISUAL DISTANCE

(b), leaving (a) visible.



a b a



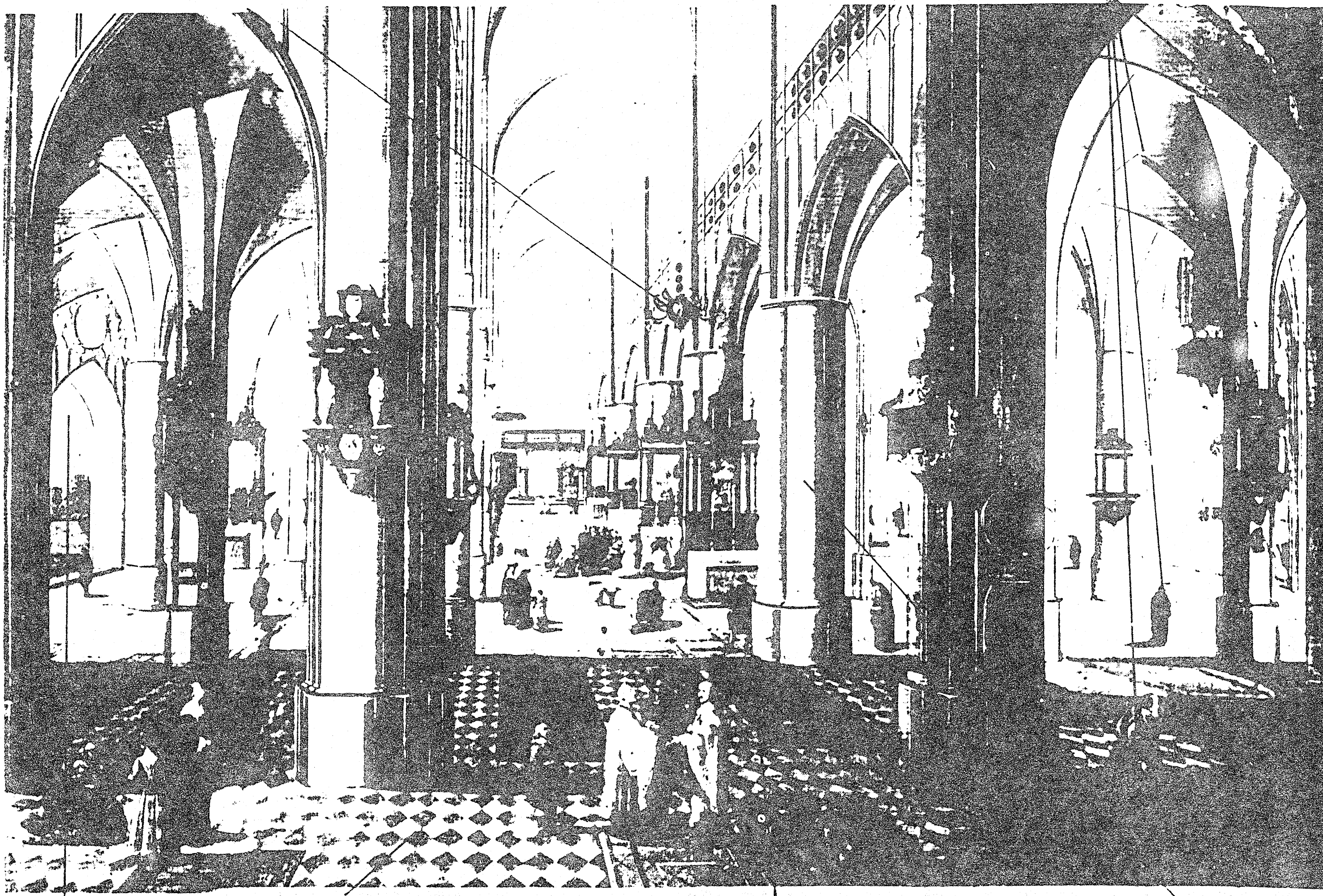
b

...s, is the neural ...
our heads? And
as just having en...
tion represented
active? Of cours...
would also be ac...
the cells represe...
made up. The p...
from moment to
spectacles off or
and so forth. Bu...
descriptions bei...
always as 'grand...
sented by a singl...
period we see he...
aspects of grand...
features describ...
'grandmother ce...
of grannie?

The example ...
object representa...
customary exam...
single-cell object
mother cell theo...

This idea has ...
that we have a se...
that we can ask: ...
round? It is diffi...
the probable ans...
cells in the huma...
proportion of th...
broadly consider...
different objects,

MONOCULAR CUES TO DEPTH



GESTALT

PERCEPTUAL ORGANIZATION

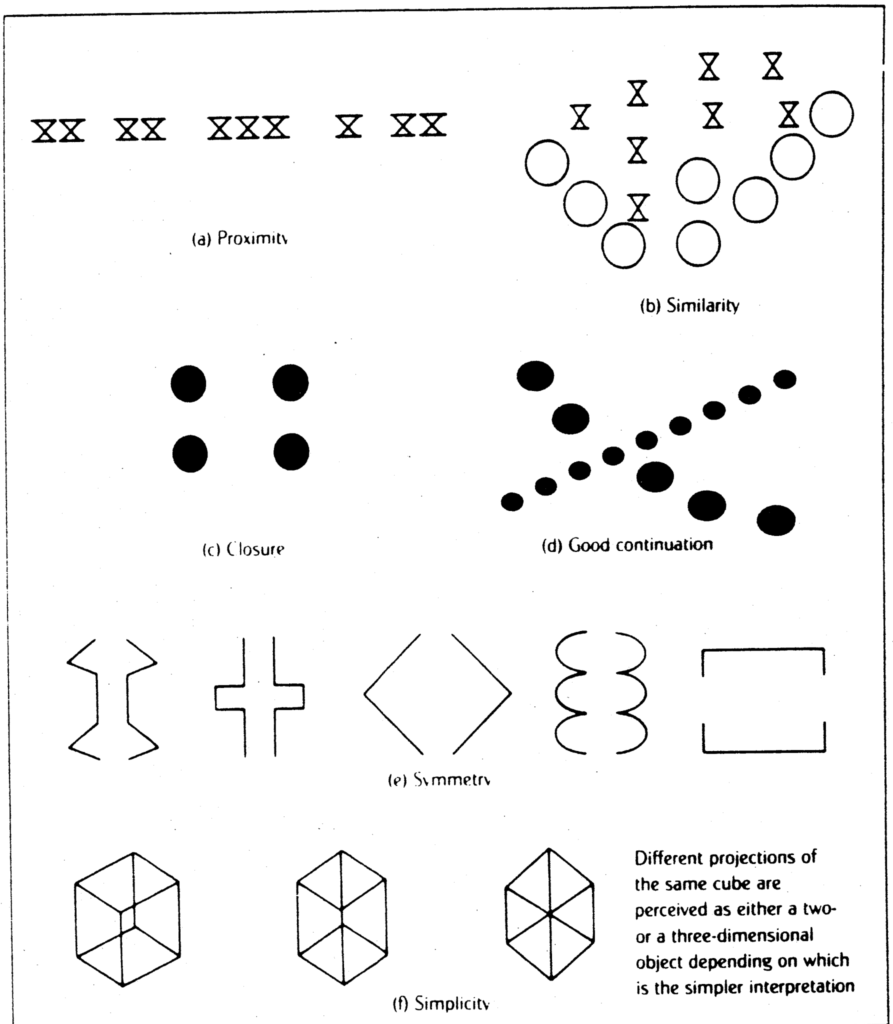


FIGURE 8-8
The Gestalt Laws of Perceptual Organization.

(a) Proximity. (b) Similarity. (c) Closure. (d) Good continuation. (e) Symmetry. (f) Simplicity.

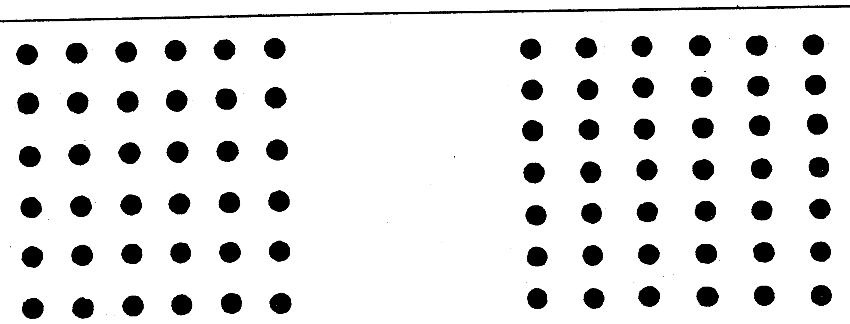
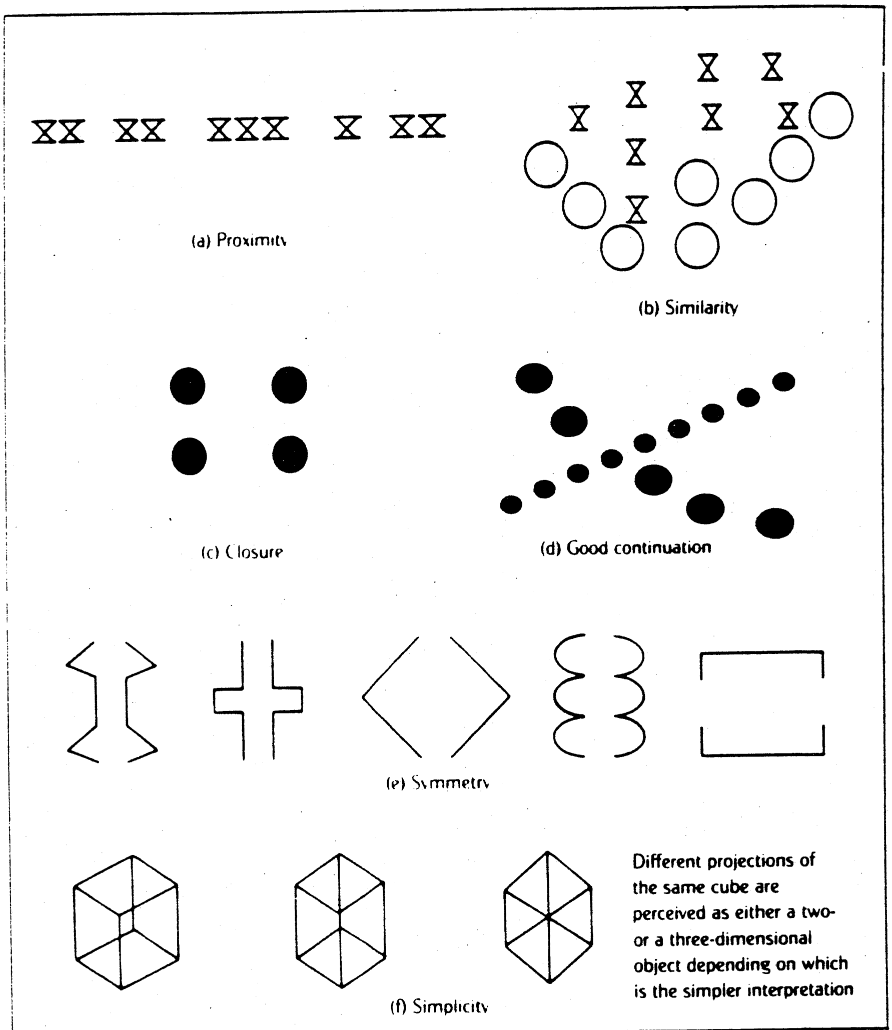


FIGURE 8-9 Proximity Grouping Can Be Altered by Recent Experience.

When first viewed, the grouping of the dots on the left is ambiguous. After looking at the array on the right for one or two minutes, however, the array on the left appears to be grouped into rows.

GESTALT

PERCEPTUAL ORGANIZATION



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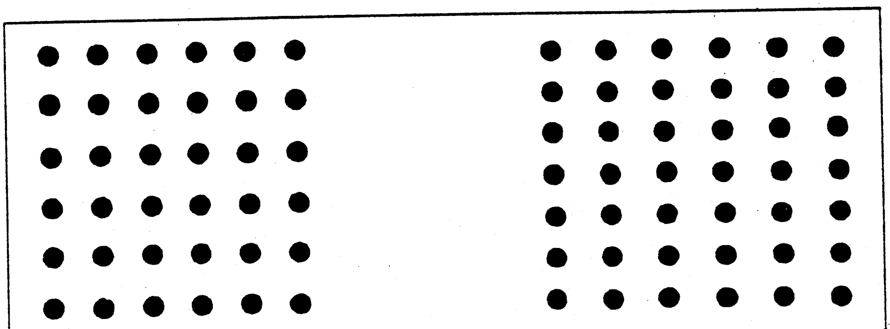

FIGURE 8-9 Proximity Grouping Can Be Altered by Recent Experience.

When first viewed, the grouping of the dots on the left is ambiguous. After looking at the array on the right for one or two minutes, however, the array on the left appears to be grouped into rows.

IMAGE ANALYSIS

VISION LEVELS

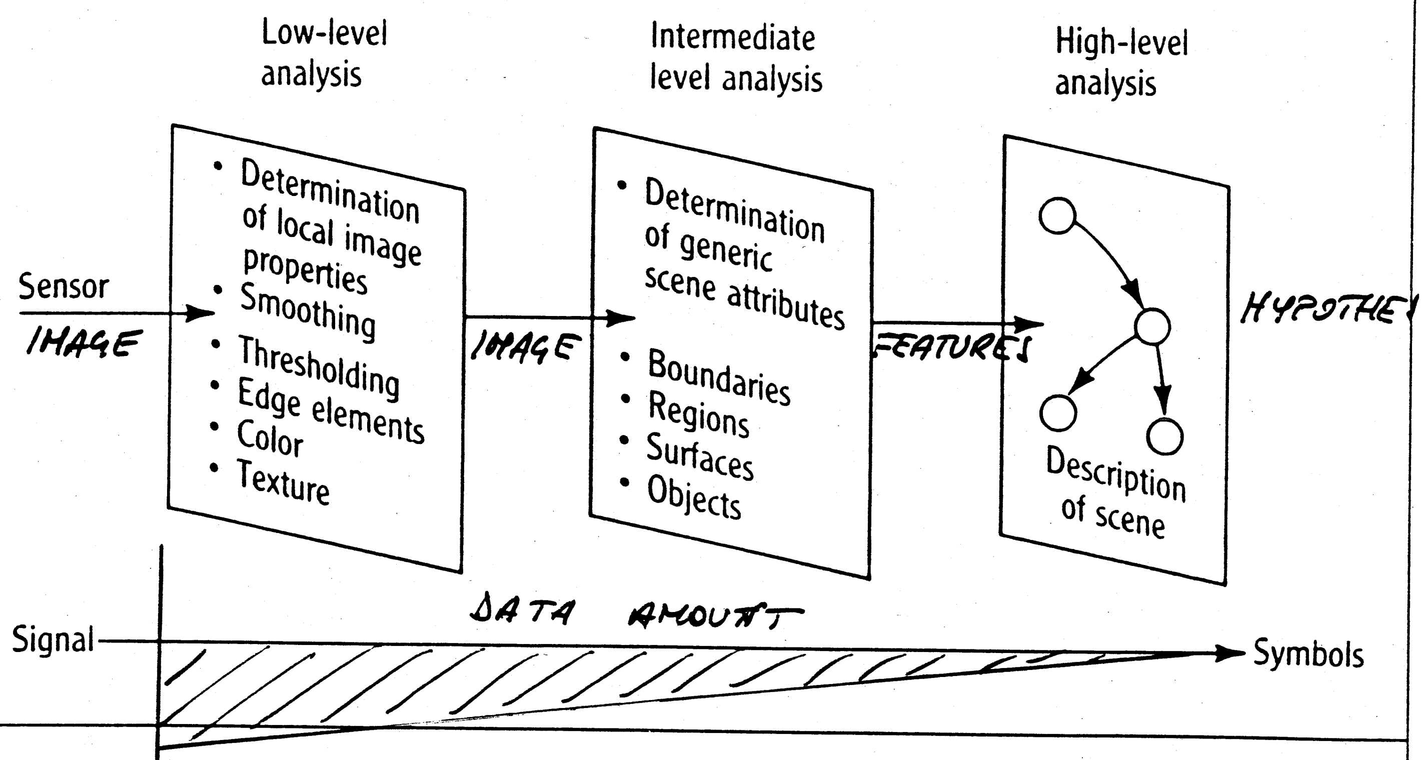

FIGURE 9-1 The Signals-to-Symbols Paradigm for Computational Vision.

Raw sensed data are transformed into a description of the scene by a series of inductive steps.