
2D Animation

Visual Imaging in the Electronic Age

Donald P. Greenberg

December 1, 2020

Lecture #21



Motion



© National Geographic

Animation is not producing

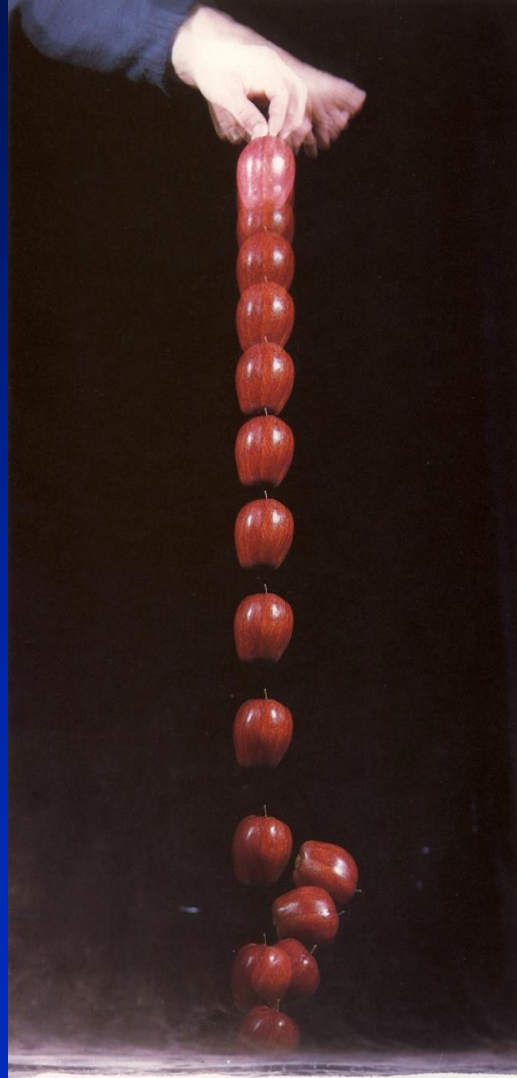
“Drawings which move”

but rather

“Motions which are drawn”

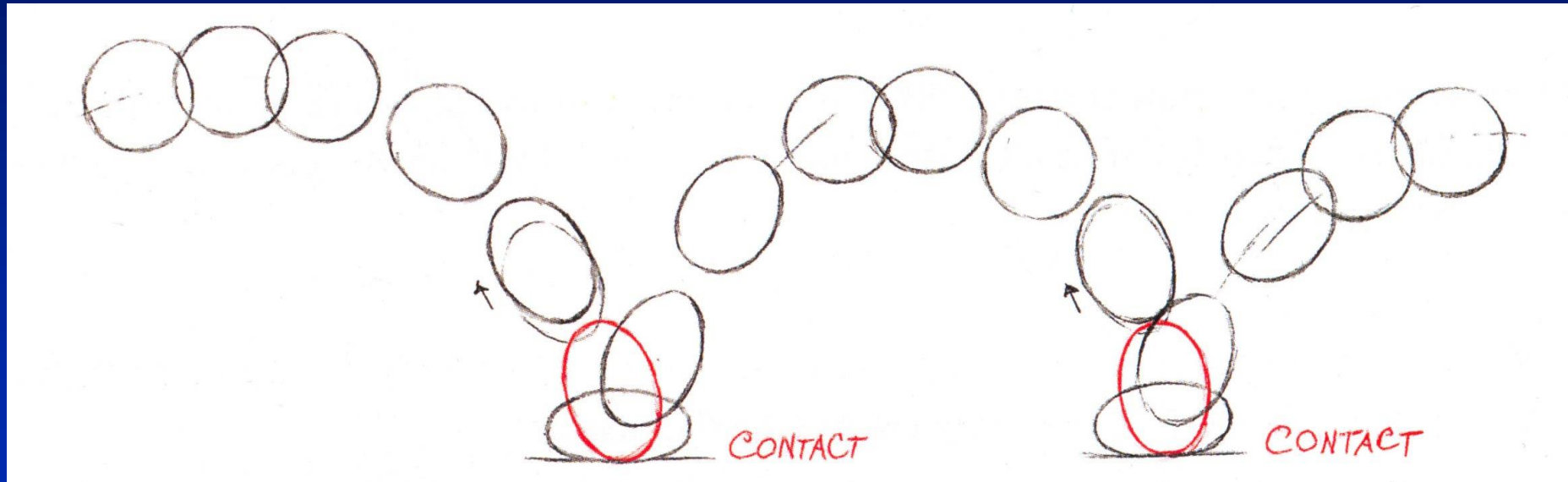
– *Disney Studios*

Newton's Apple, 1970

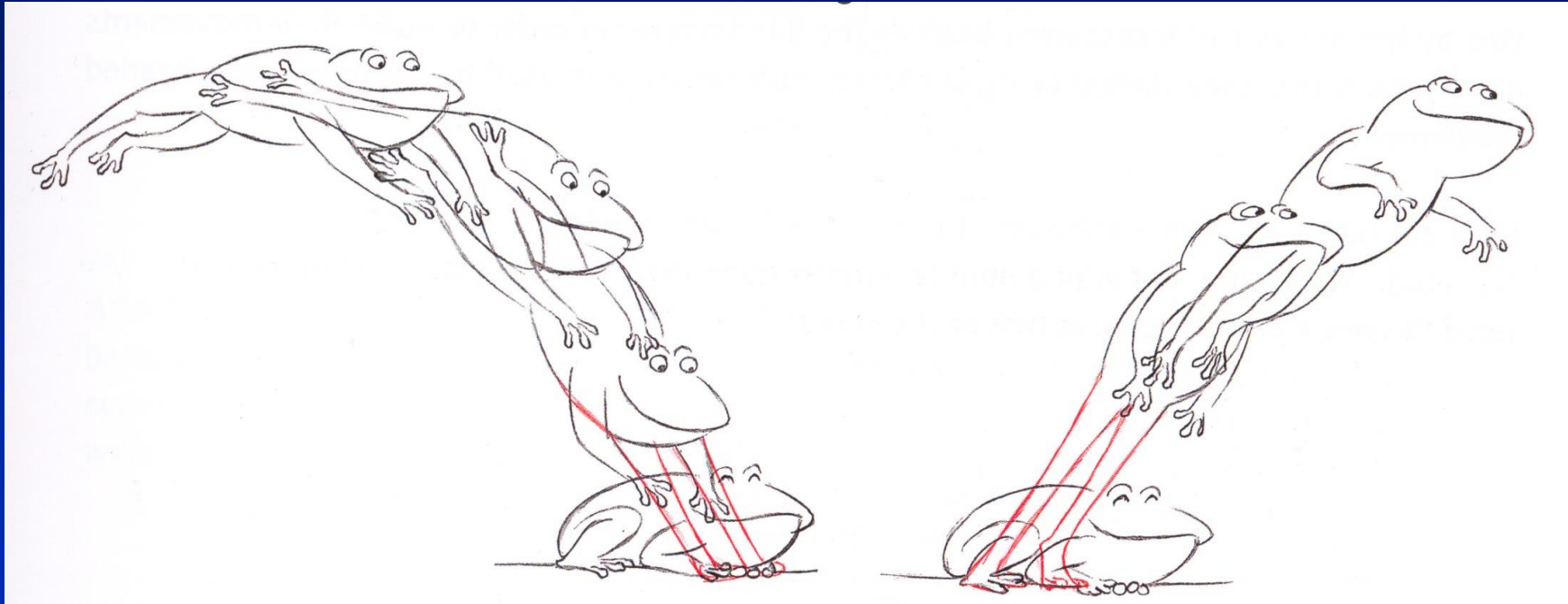


From *Stopping Time, The Photographs of Harold Edgerton* by Harry N. Abrams, 1987.

Exaggeration



Exaggeration



Zoetrope

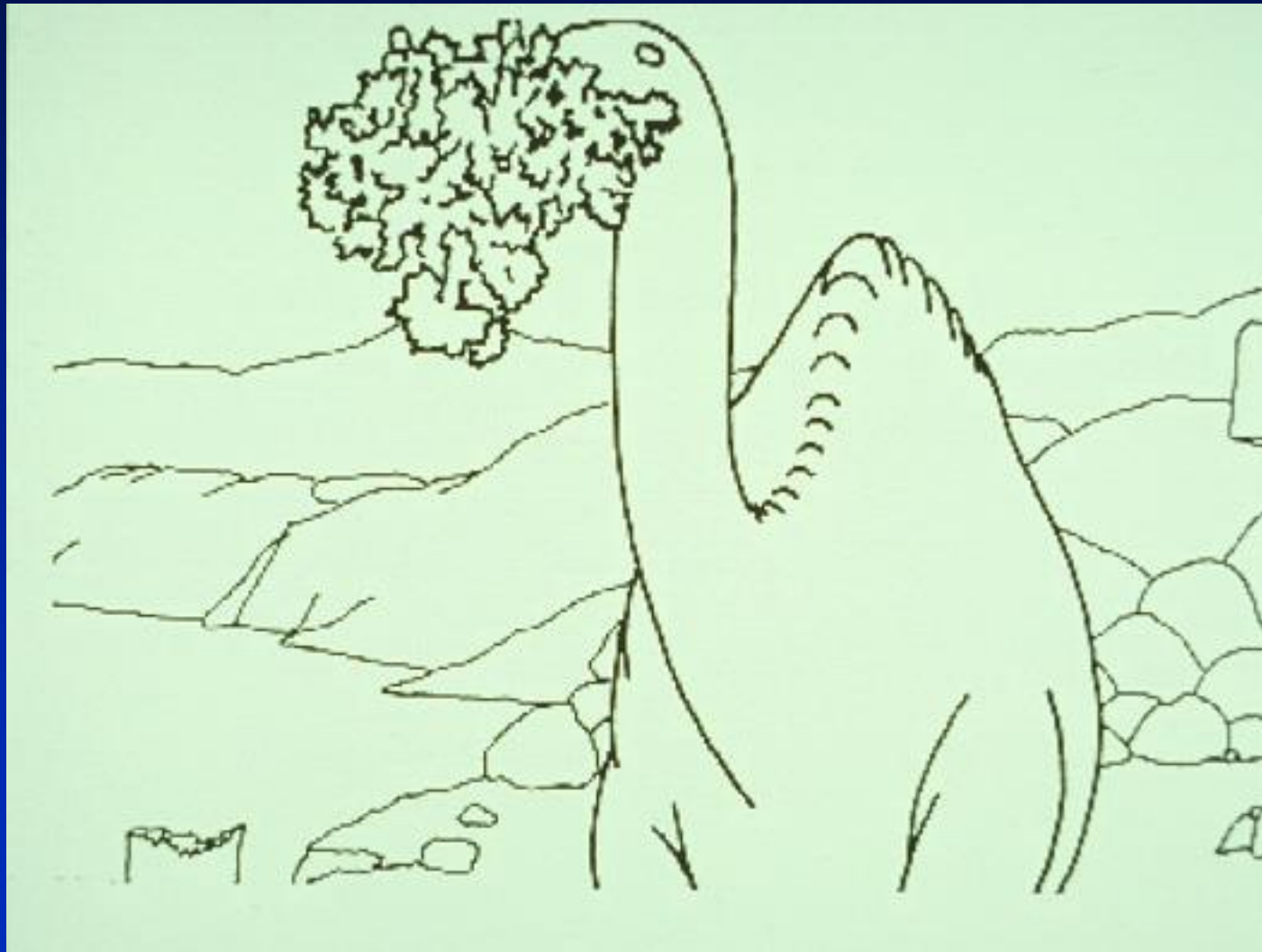
- As the cylinder spins, the user looks through the slits at the figure on the opposite side
- The scanning keeps the images from blurring together
- The user sees a rapid succession of images producing the illusion of motion

Zoetrope



Animation – Windsor McKay's Gertie

1914



Felix the Cat

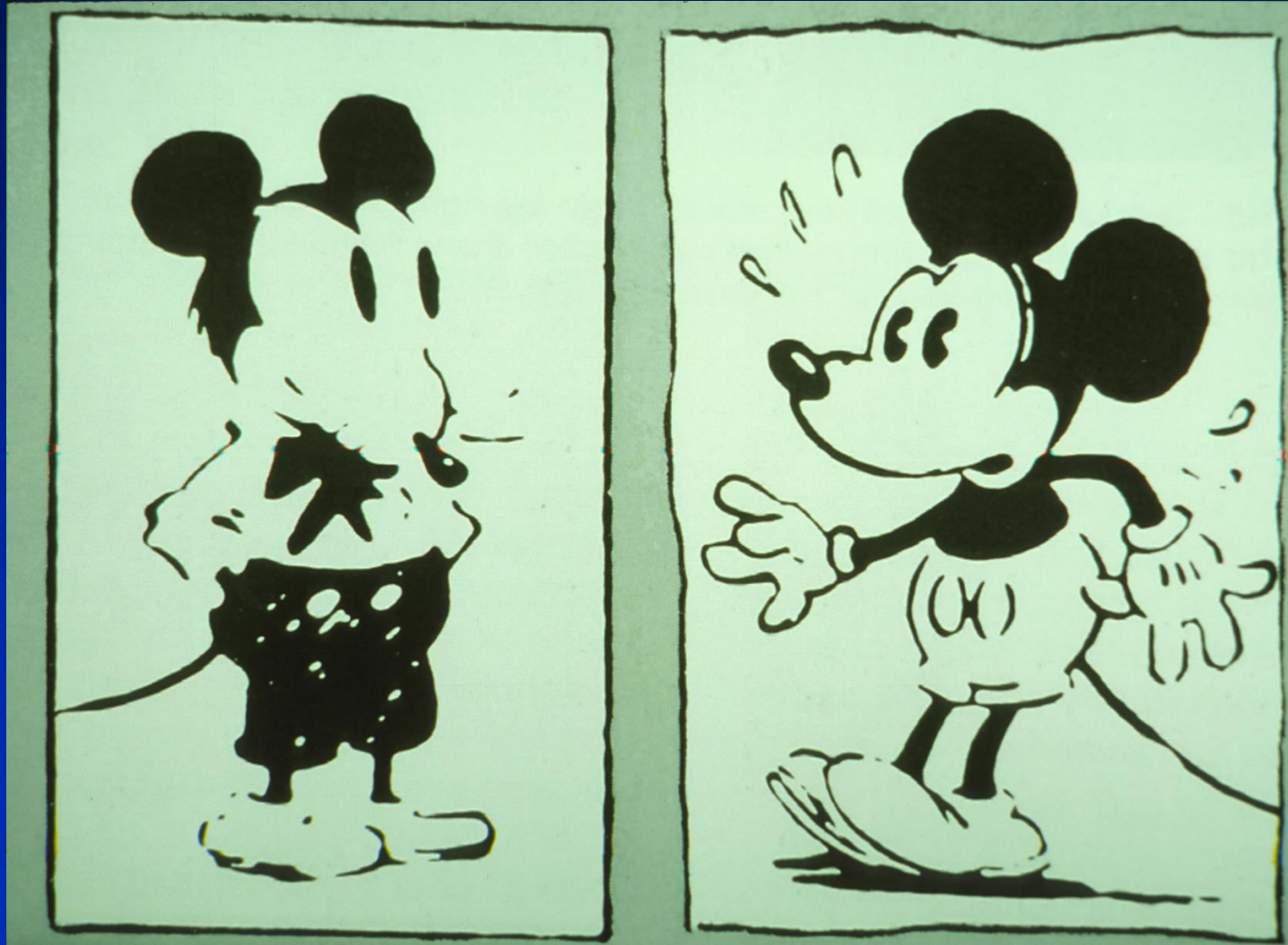
1939 World Fair



Walt Disney



Mickey Mouse



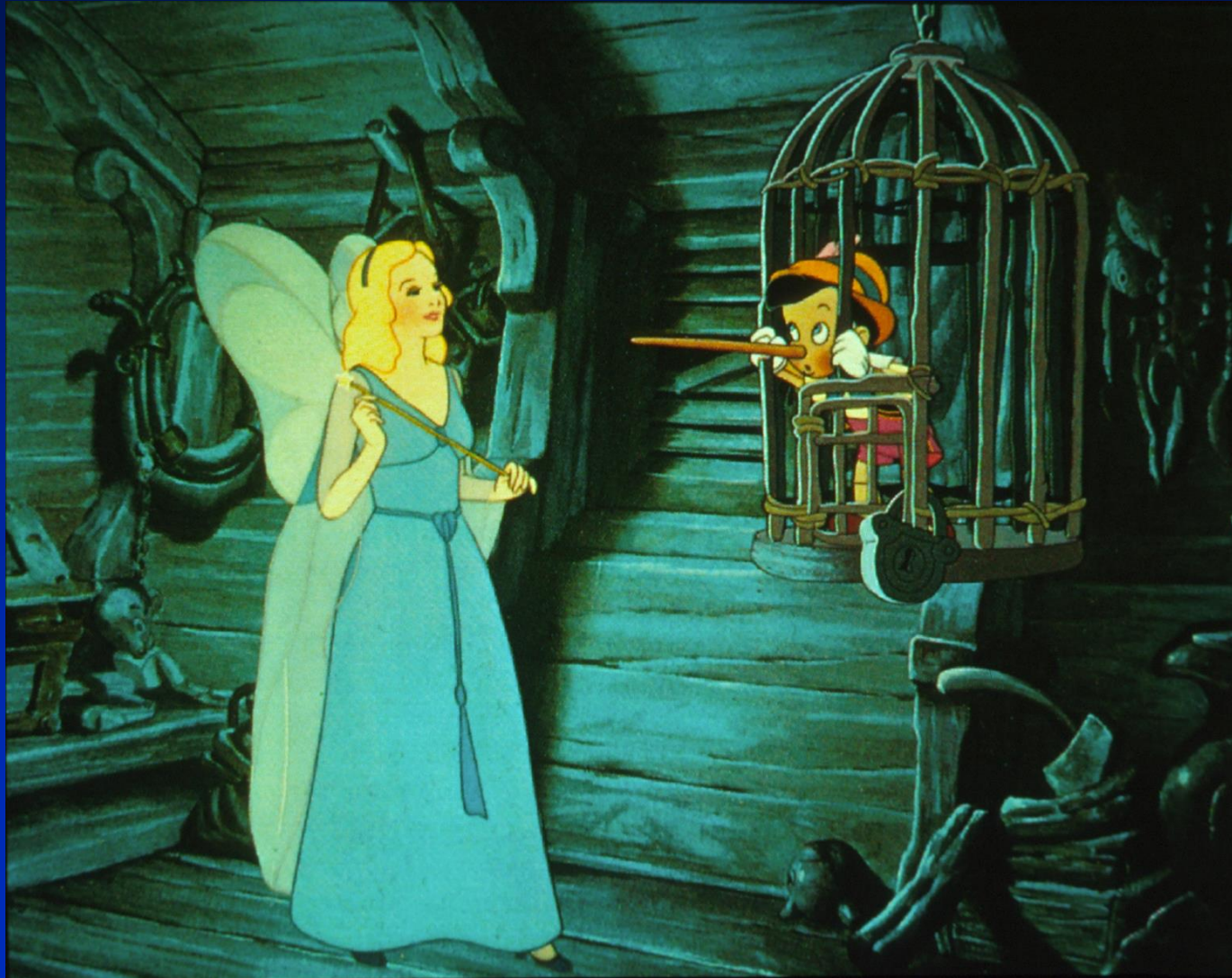
Snow White

Disney 1937



Pinocchio

Disney 1940



Hannah Barbera



William Hannah



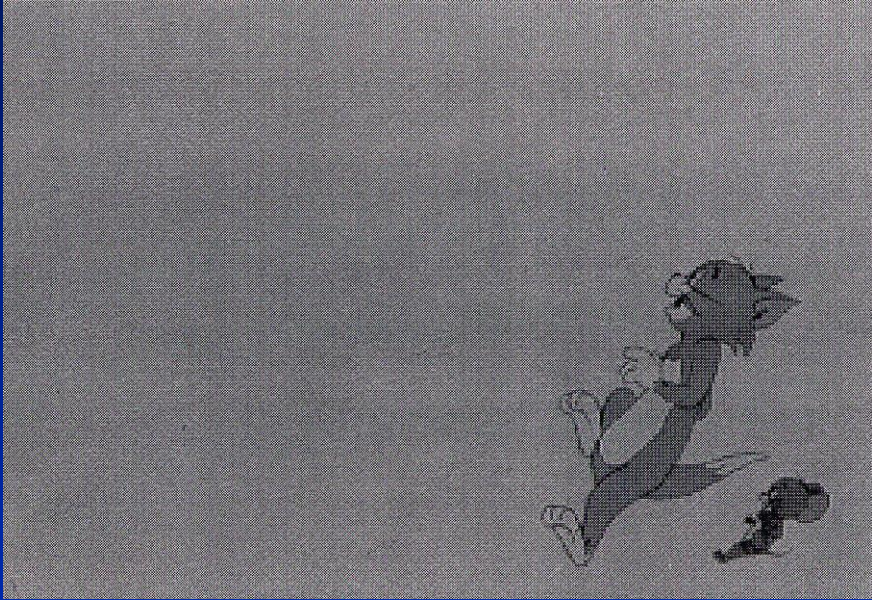
Joseph Barbera

2D Cel Animation

Cartoon Animation

- **What is cartoon animation?**
 - A sequence of drawings which, when viewed in rapid succession, create an illusion of continuous life-like movement.
- **Cel animation**
 - Process in which background and action are drawn separately
 - Background and action are placed together when ready to film

Cel-animation

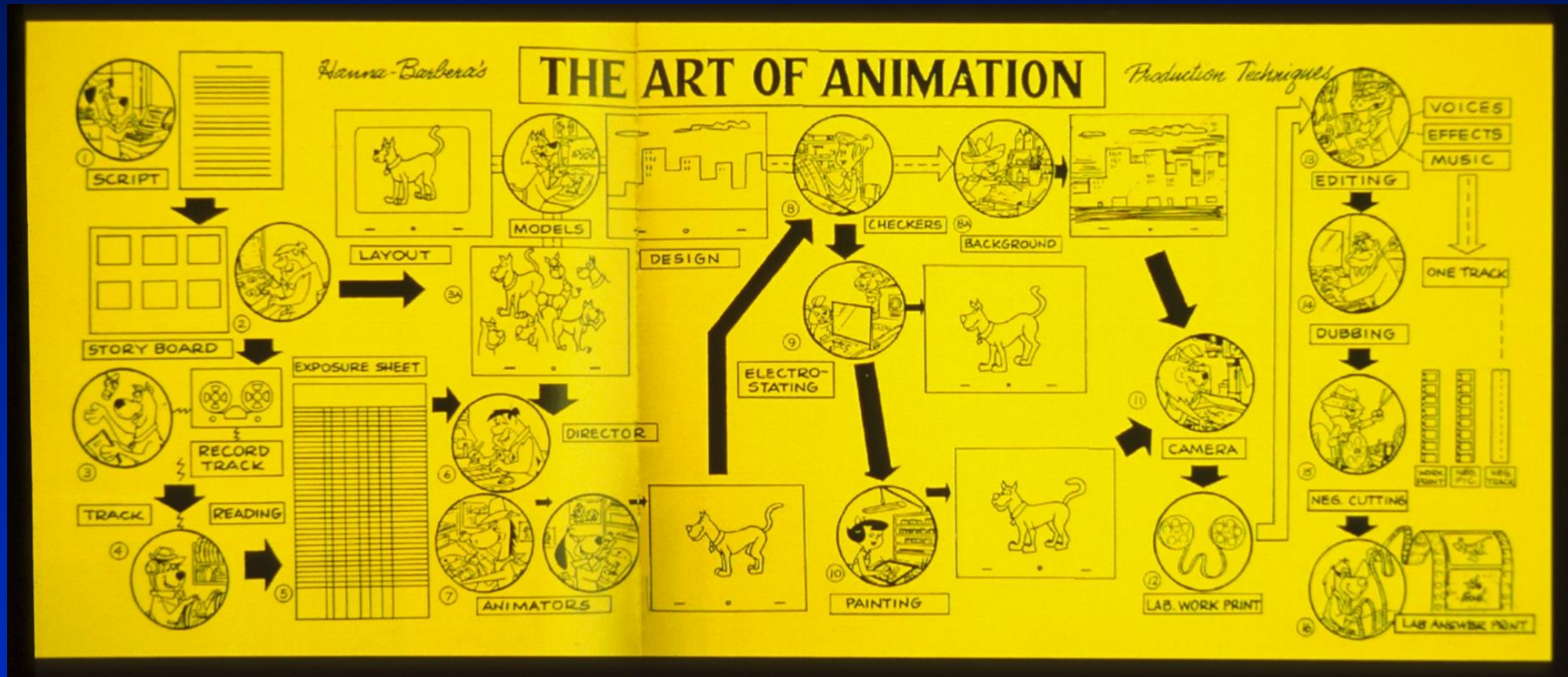


Standard Animation Cel

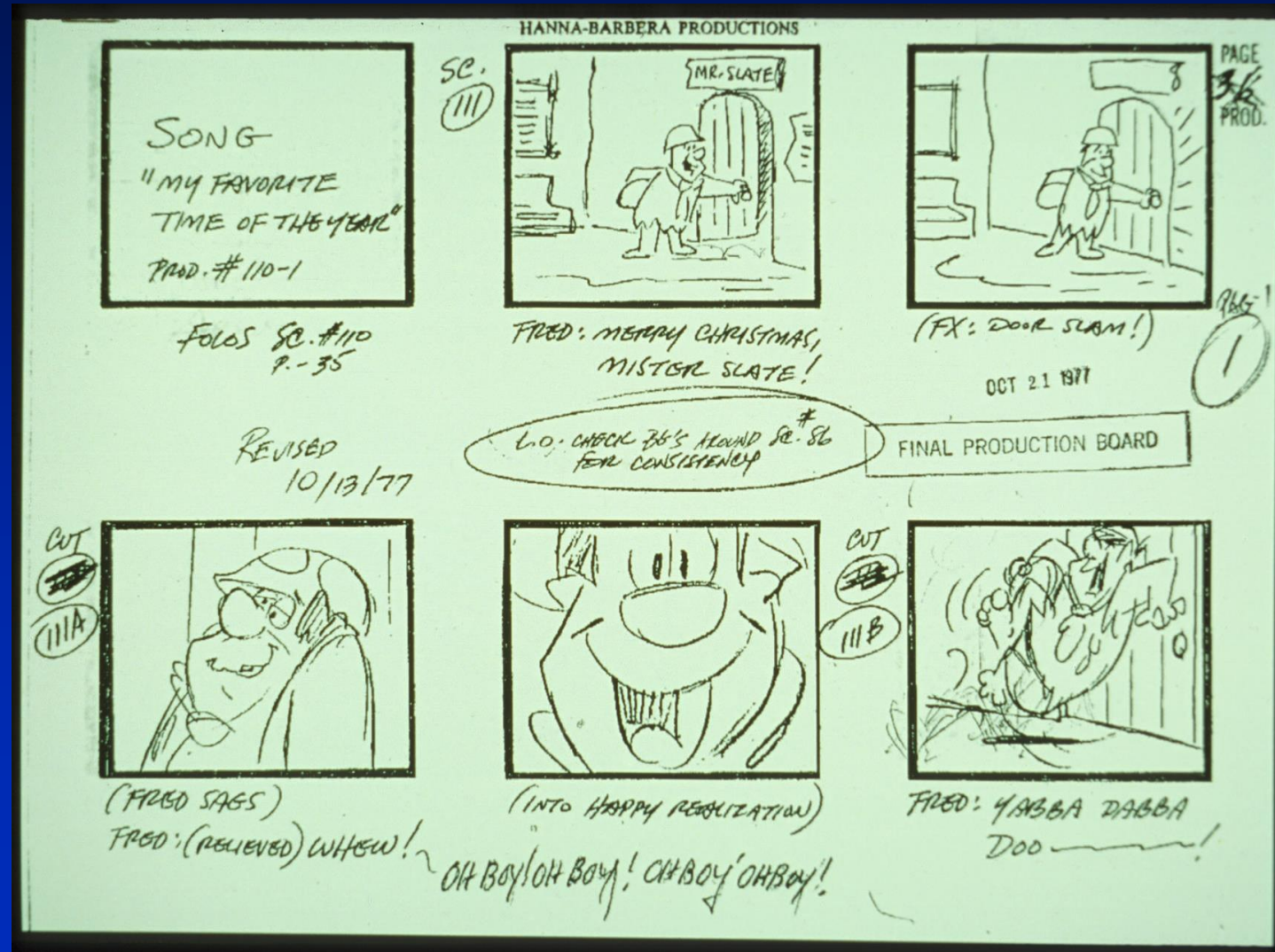


Standard Animation Cel With Background

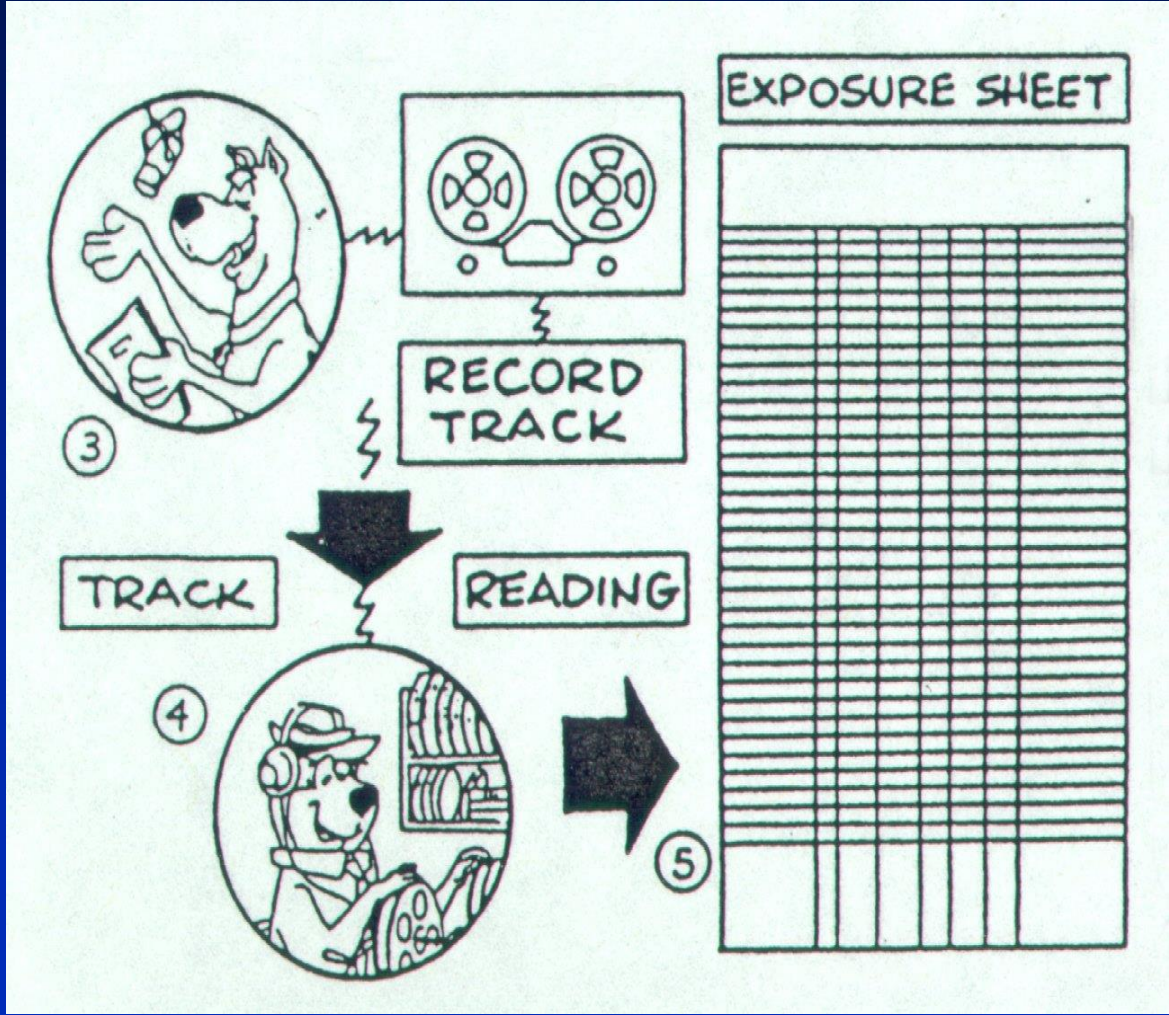
Cel-animation



Animation Storyboard

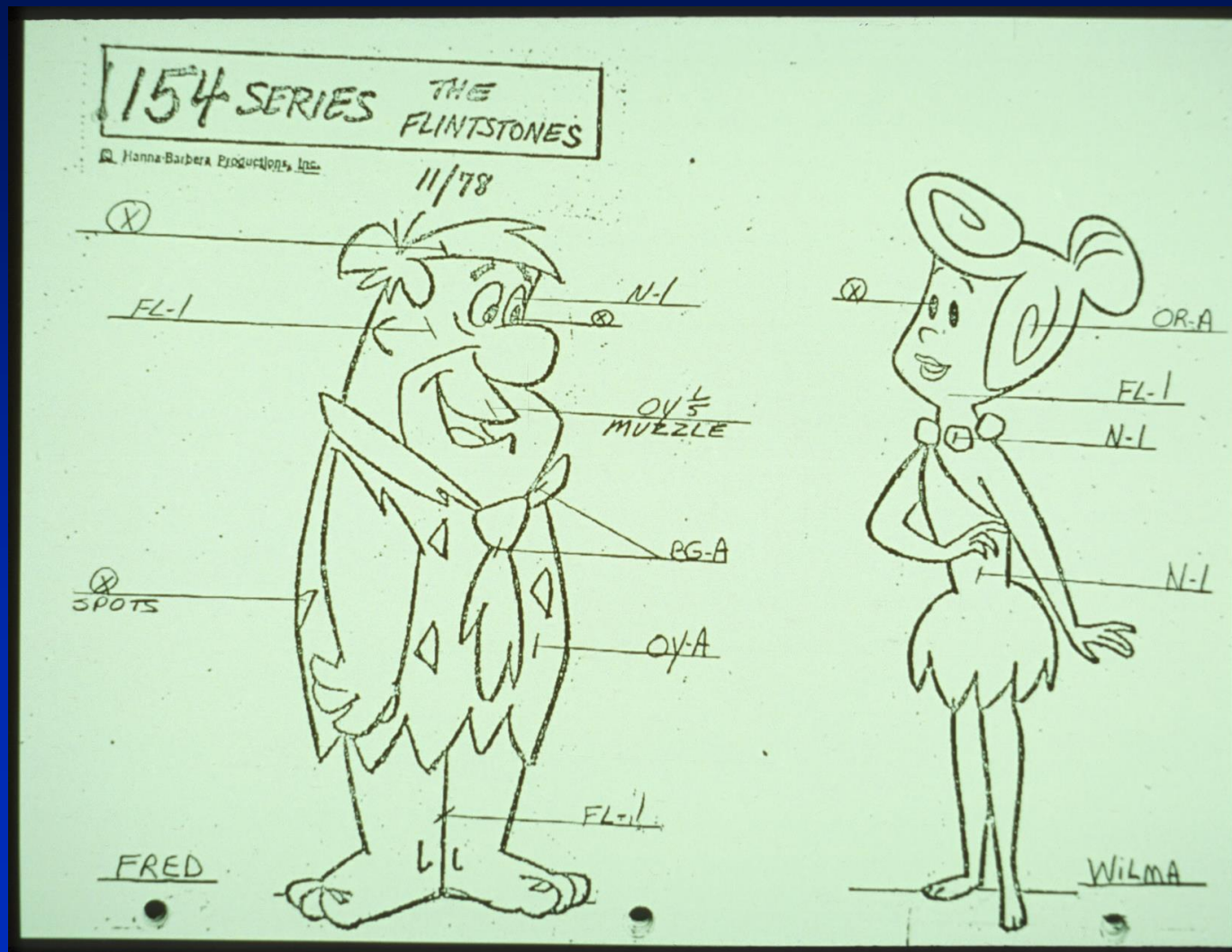


Cel-animation

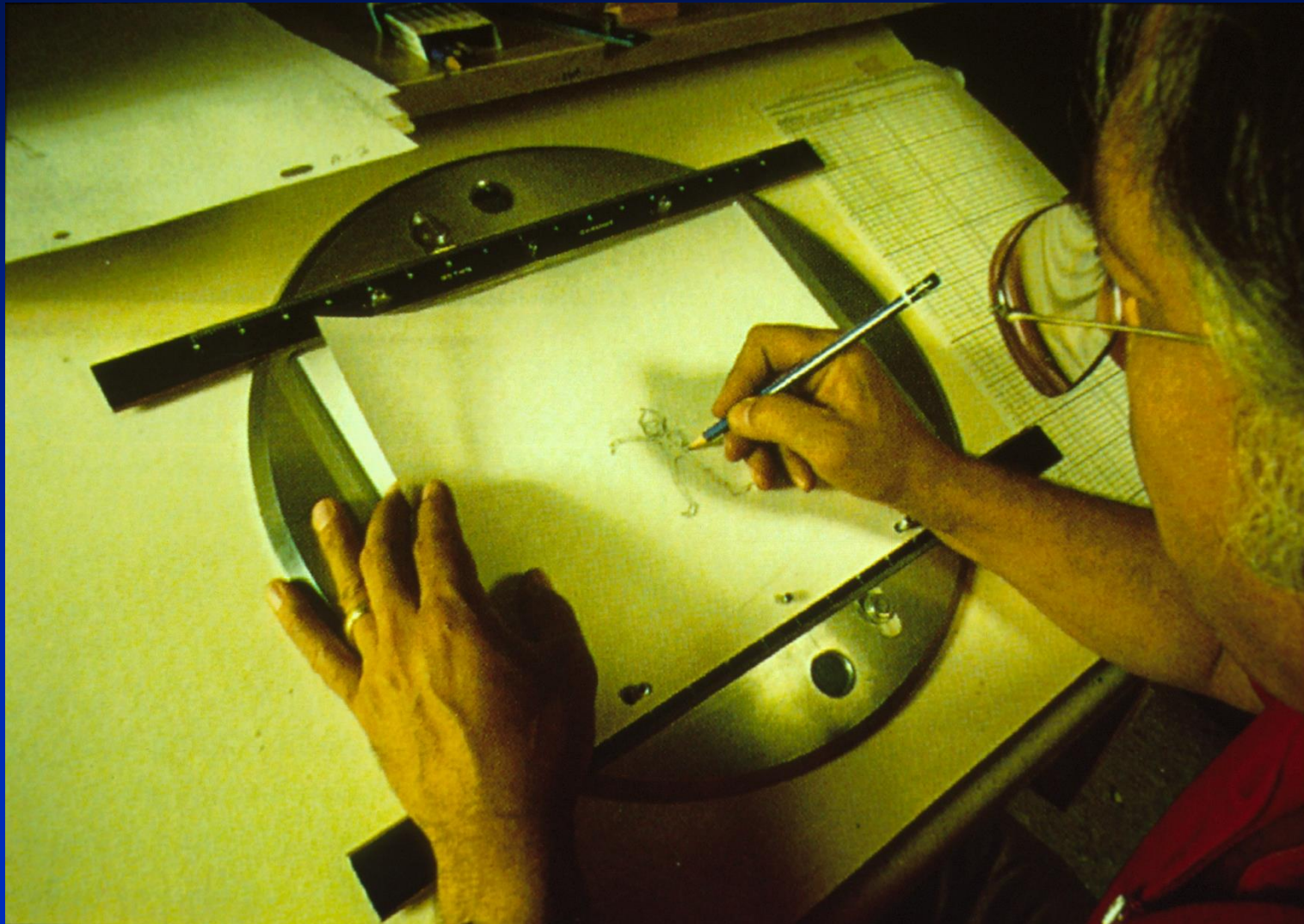


Flintstone Model Template

H-B



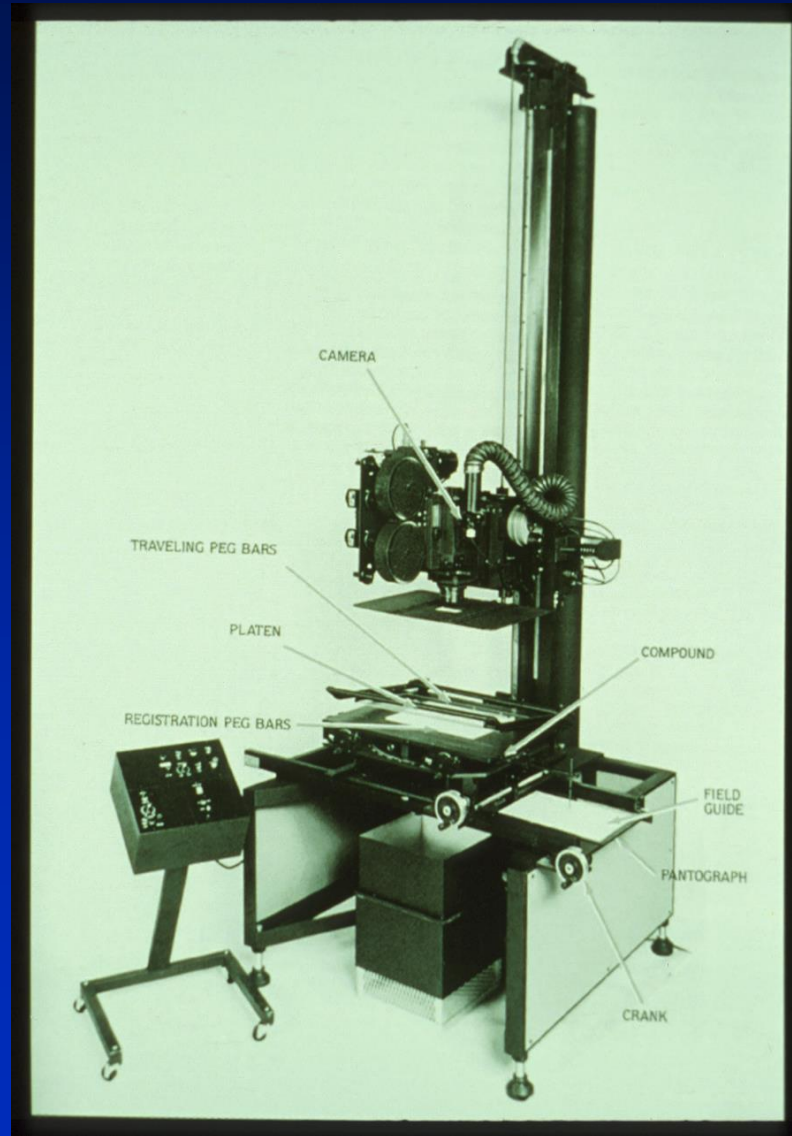
Cel-Animation



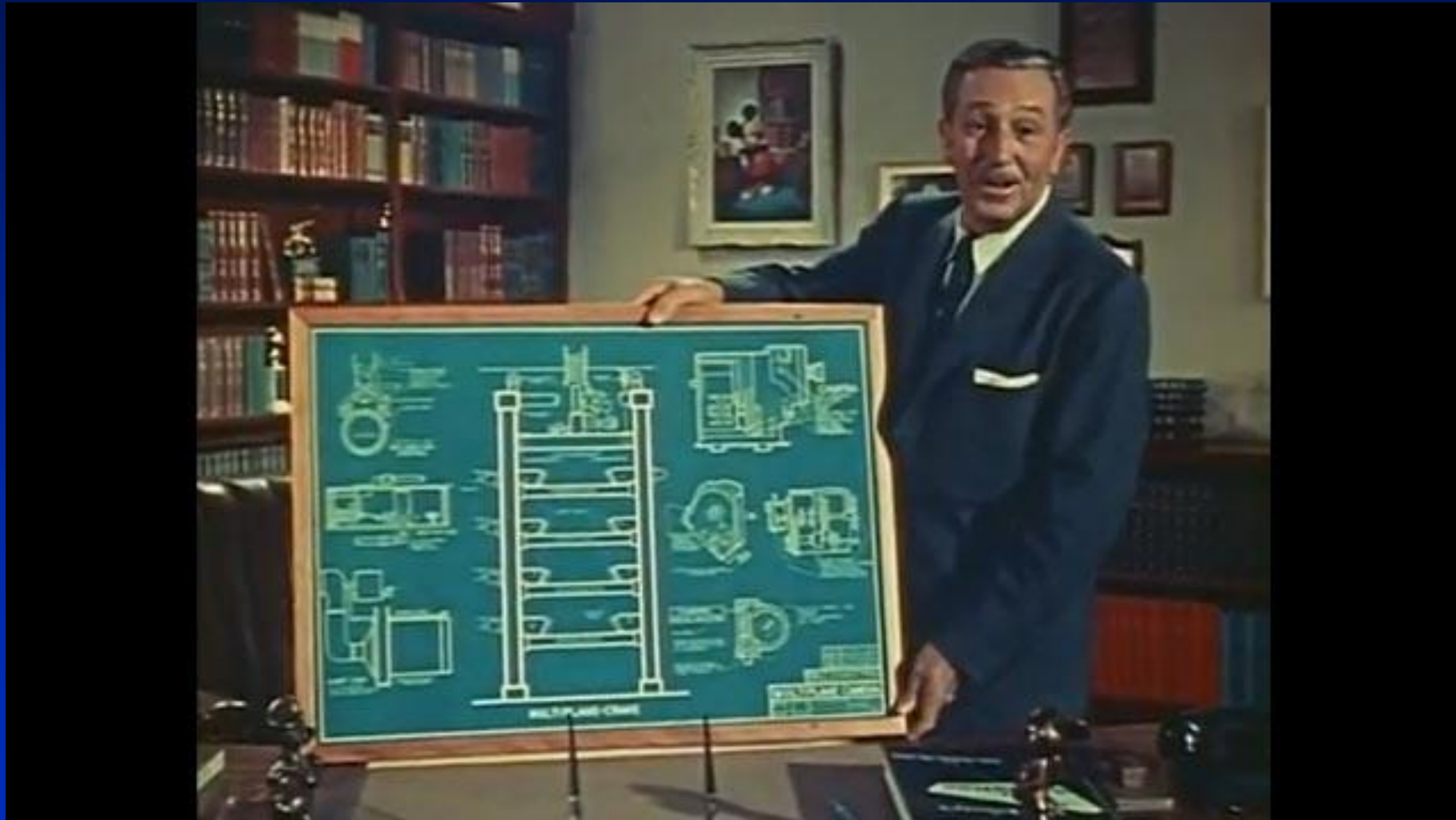
Pinocchio Background



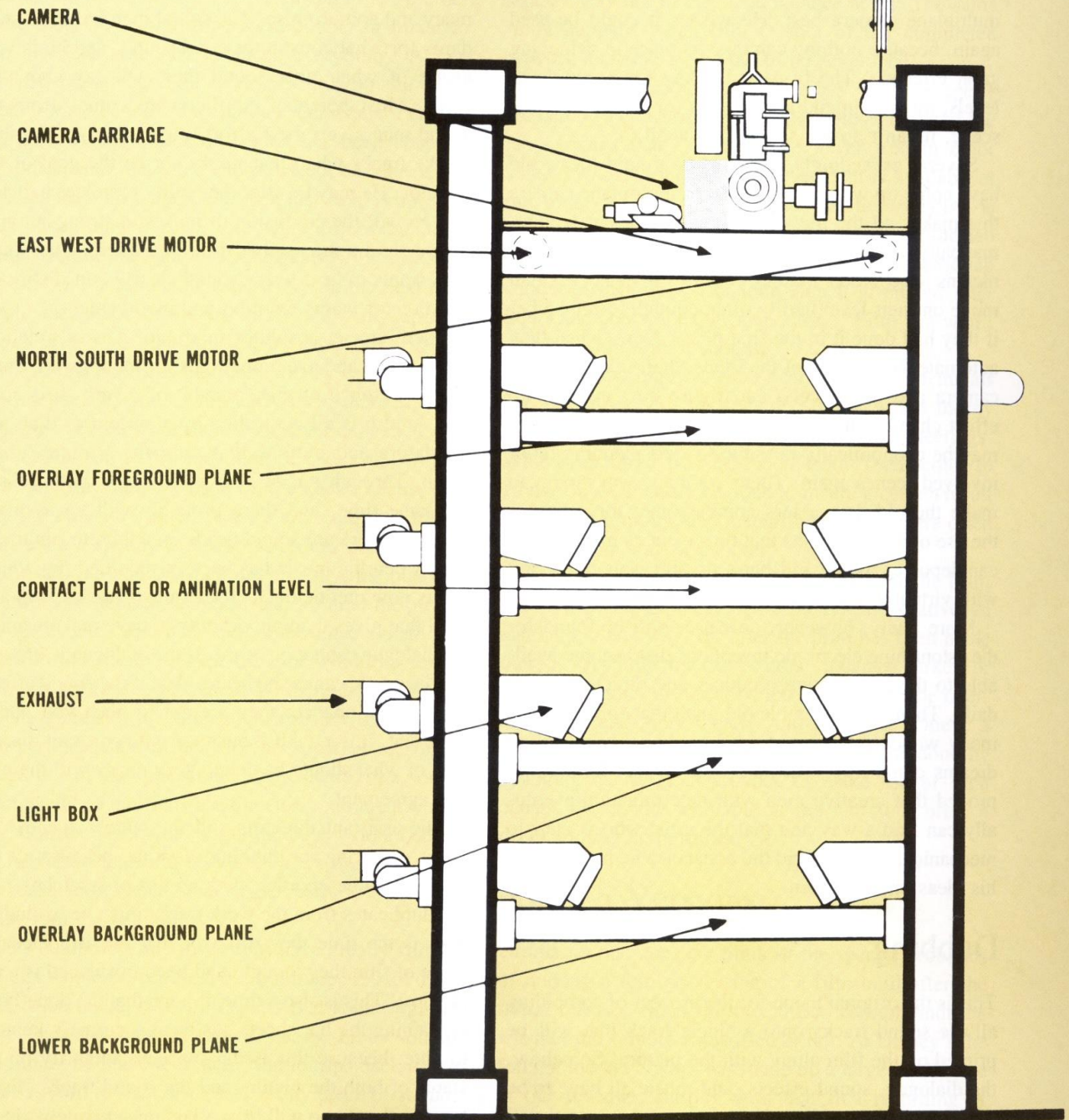
Cel animation camera stand



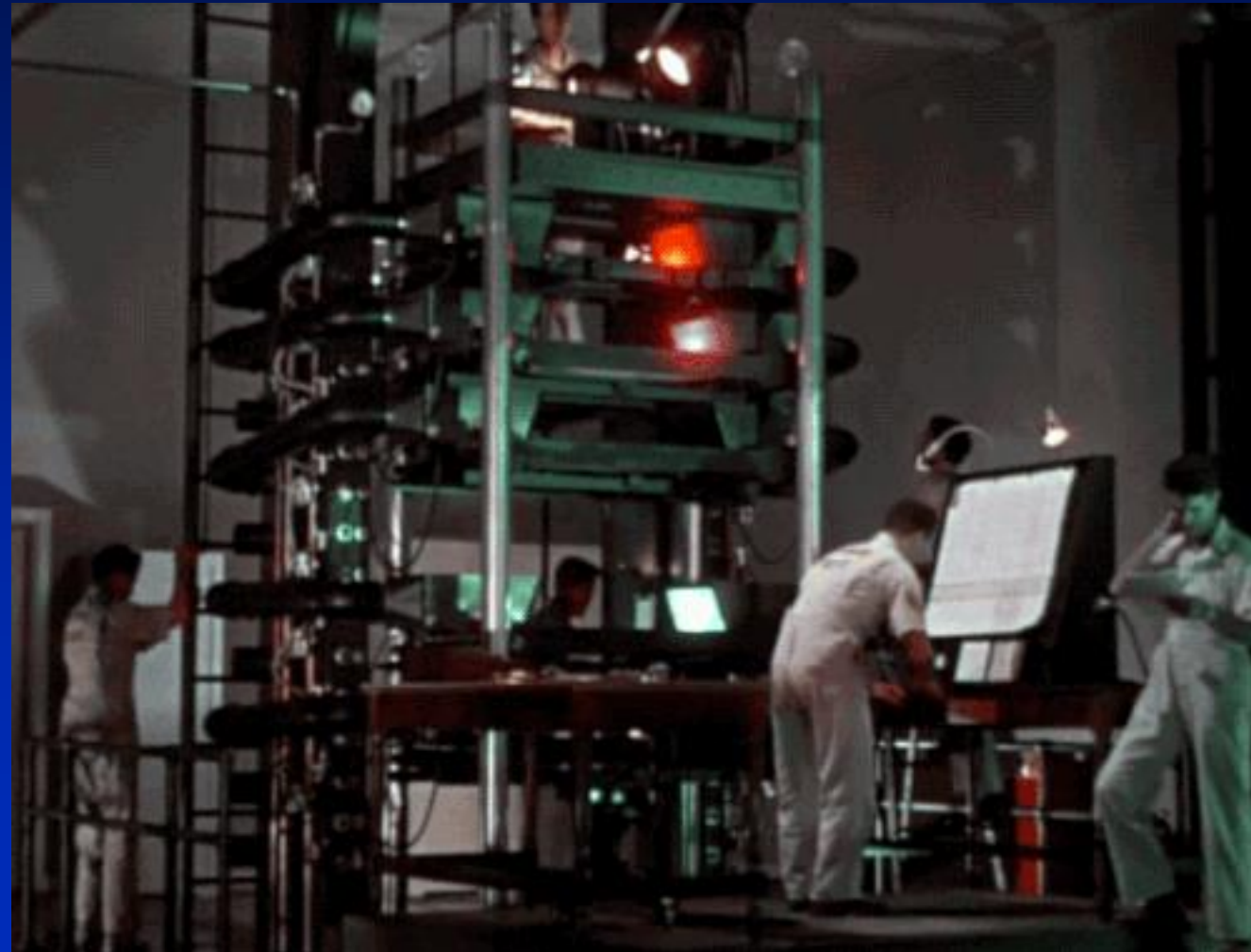
Multi-Plane Camera



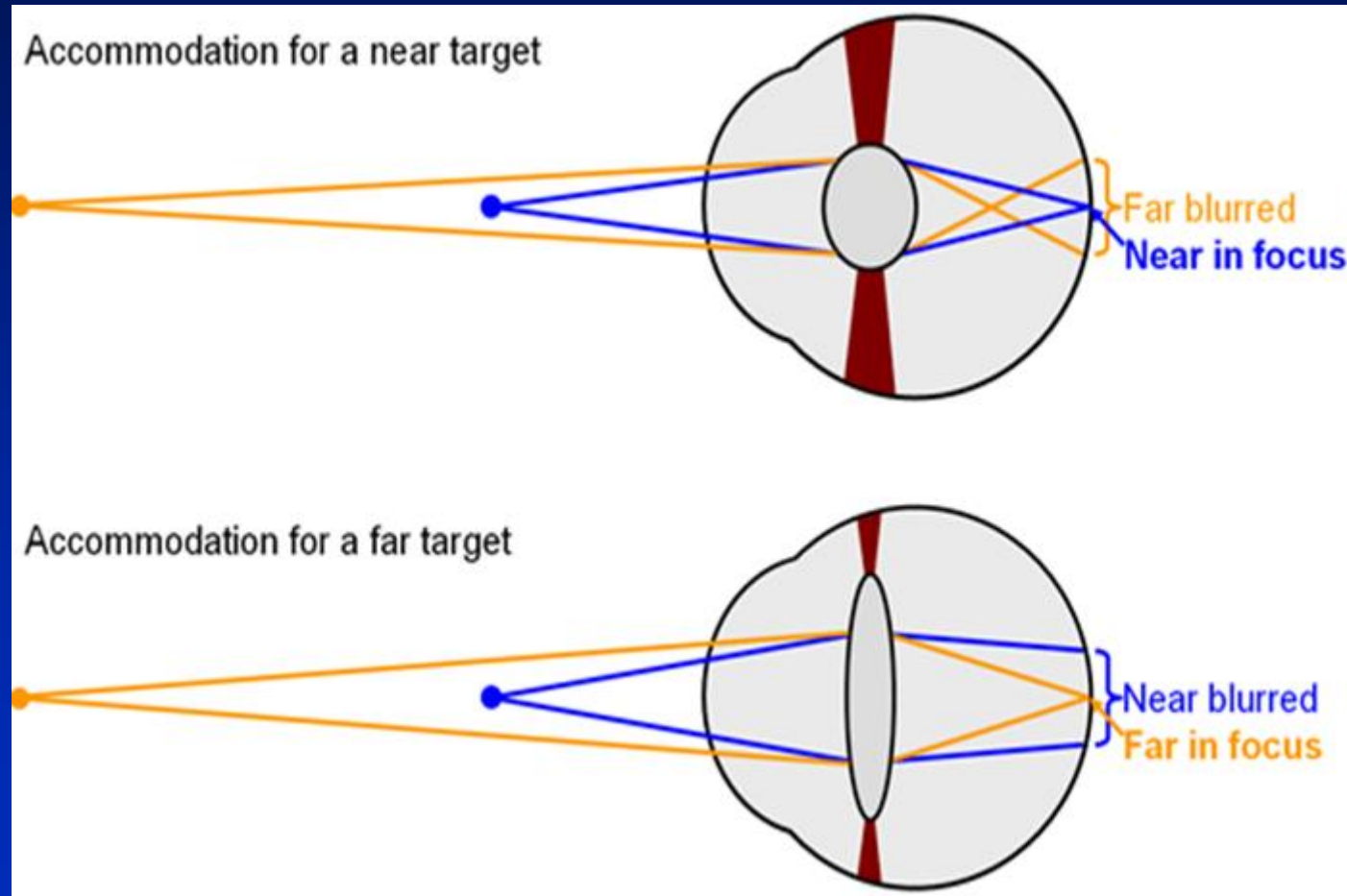
Multi-plane Camera



Multi-Plane Camera



Focus Fundamentals





c

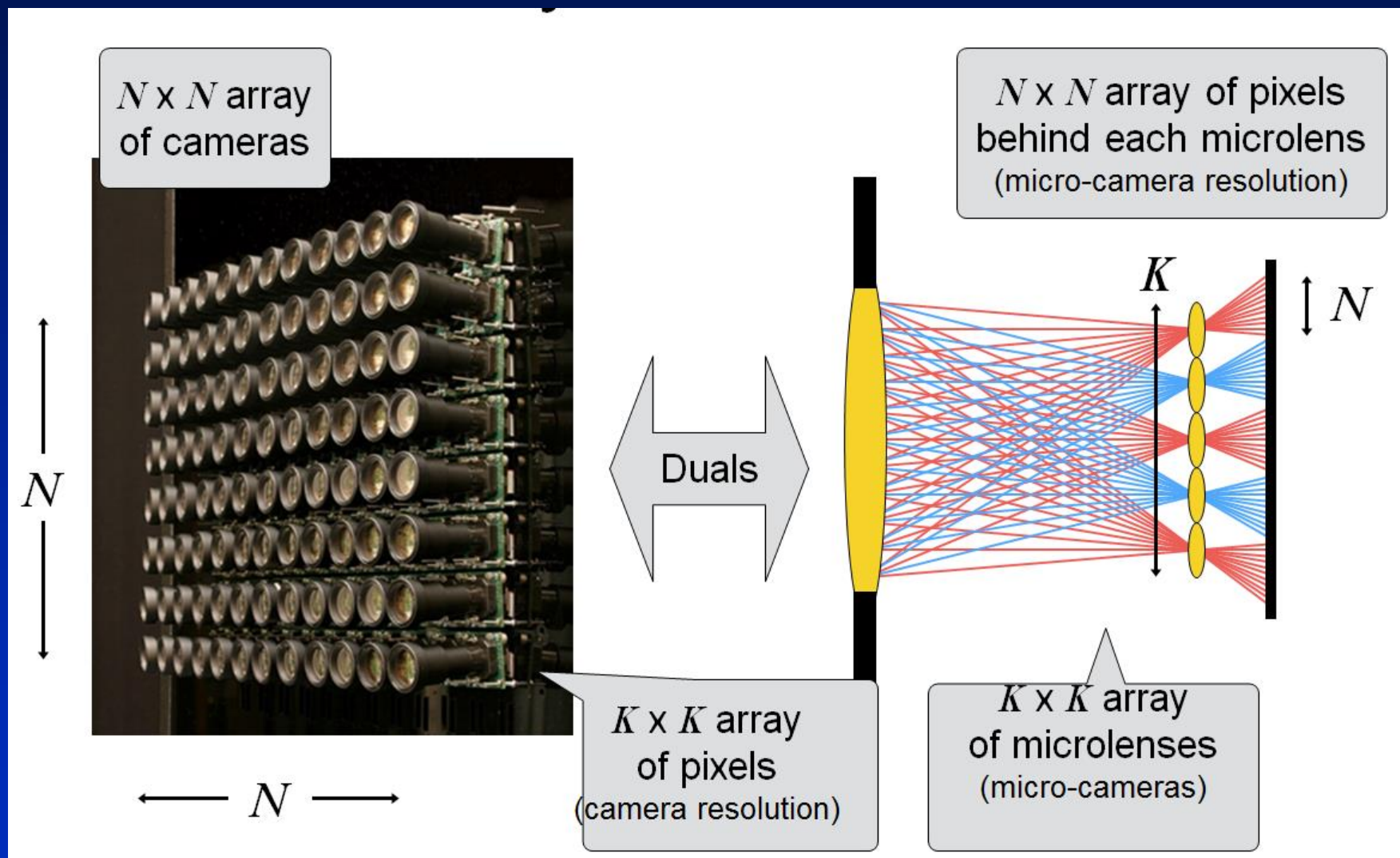
b

a



Figure 2a: Walt Disney's multiplane camera stand

Multi-camera array and LF camera are **duals**



Lytro Camera

2015



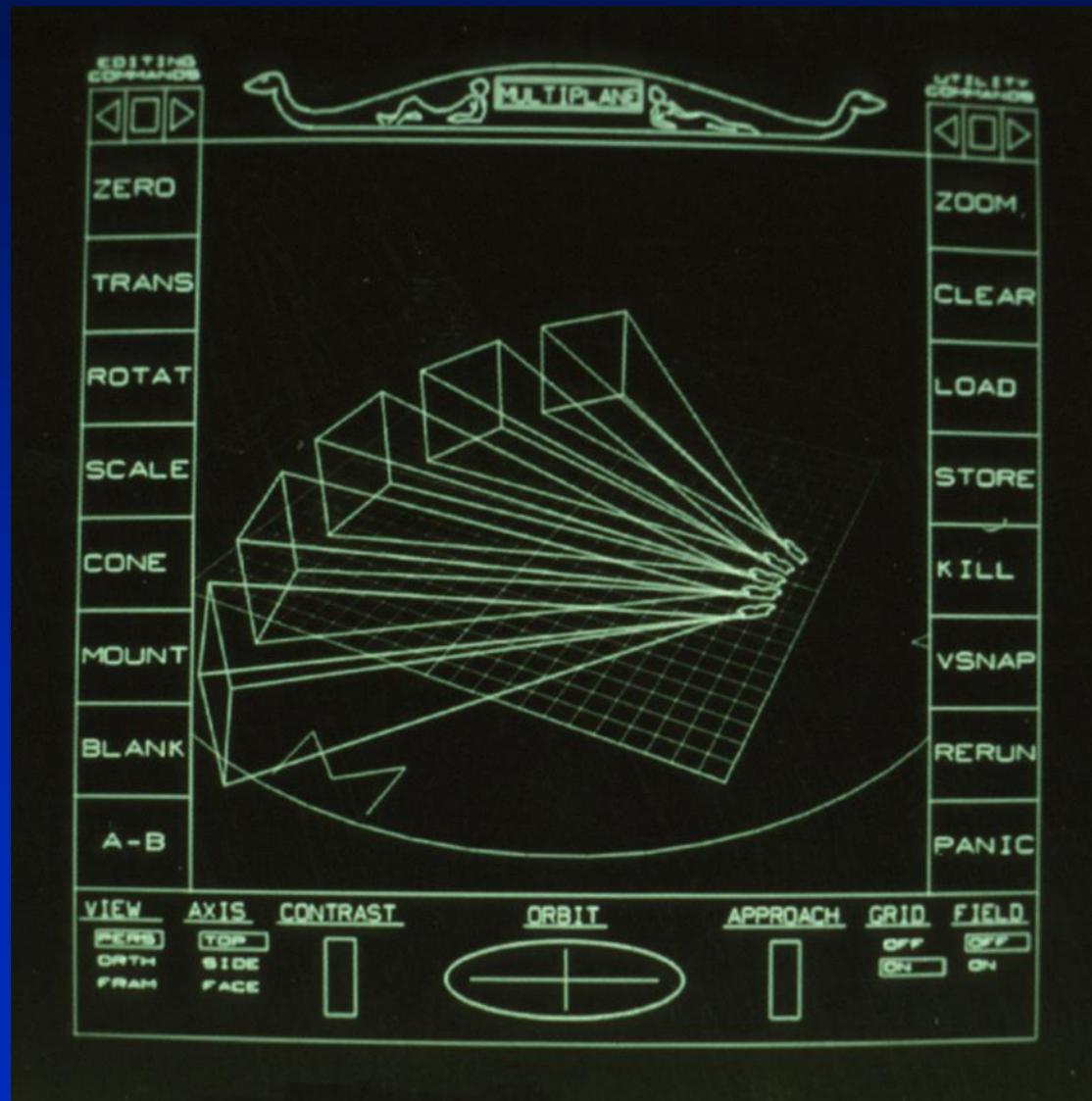
Steps for Creating Cel-animated Films

- ✓ Background is drawn and colored
- ✓ Key animator draws the most important, or key, frames of character
- ✓ In-betweeners fill in the key frames with all the action required of the character
- ✓ Cels are inked and painted
- ✓ Checker places each cel on the background and checks the quality of art and movement
- ✓ Each cel is filmed

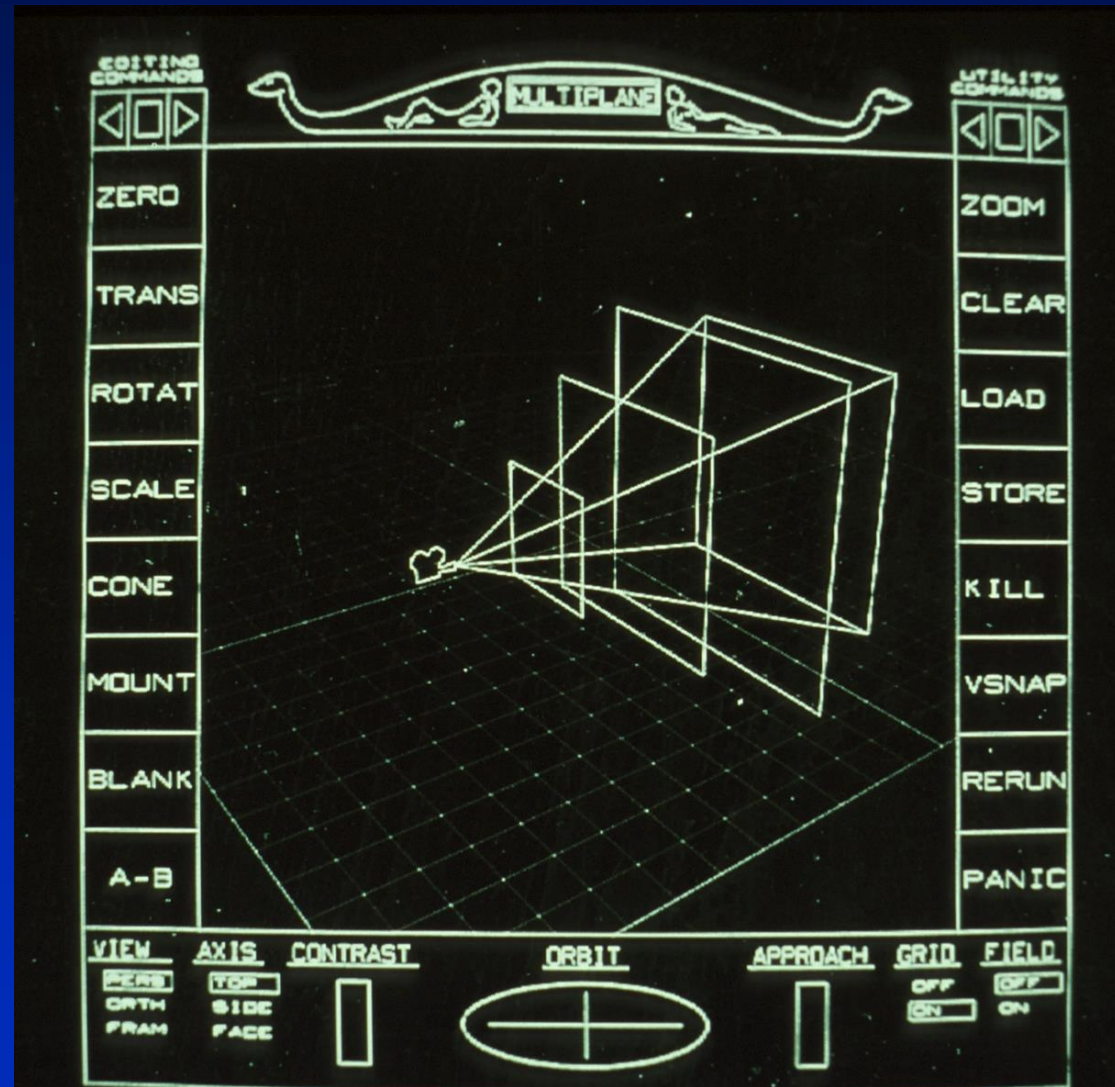
The Nereus Animation System

- Developed by Marc Levoy, 1974
 - Cornell Program of Computer Graphics

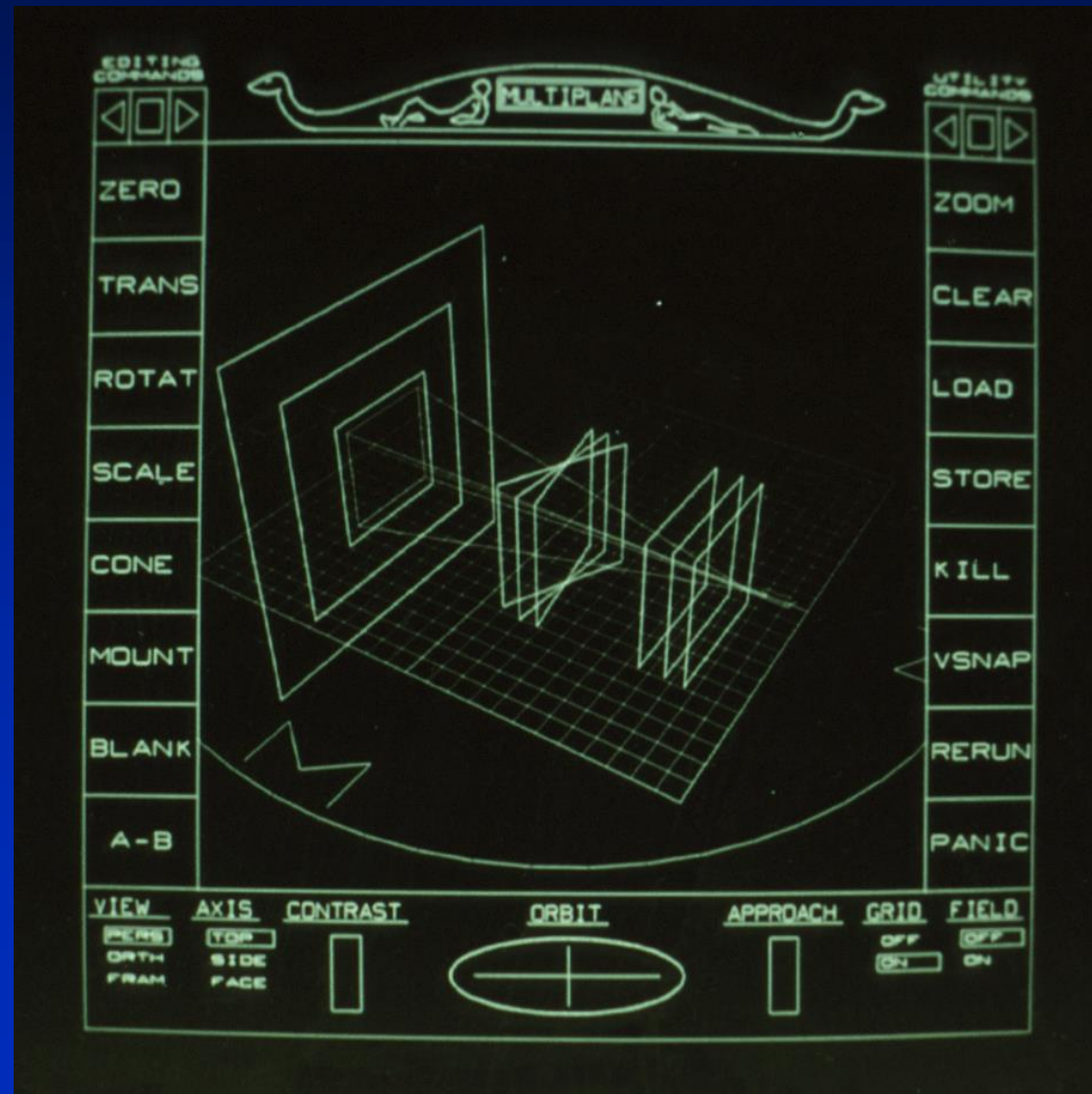
The Nereus Animation System



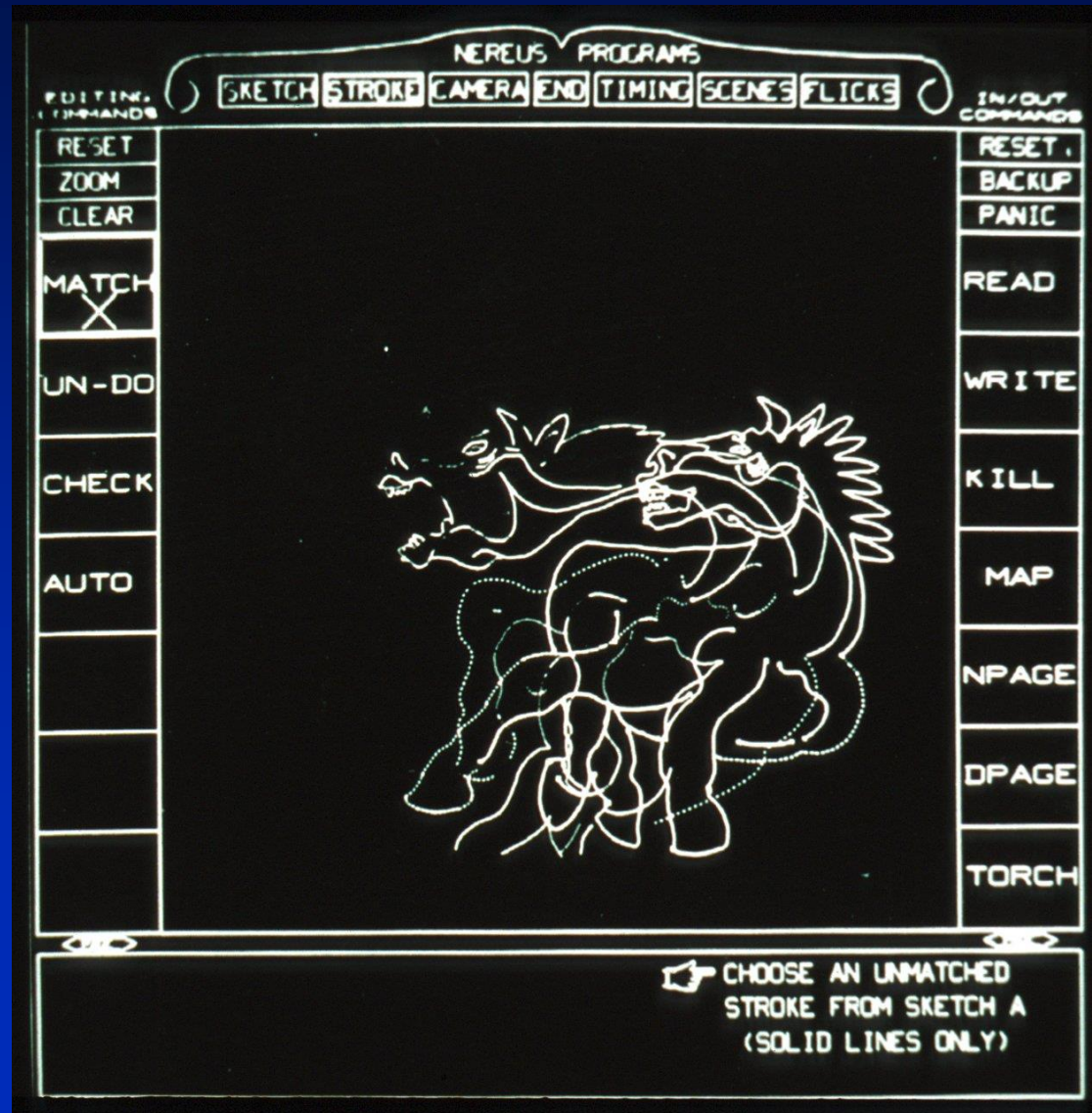
The Nereus Animation System



The Nereus Animation System



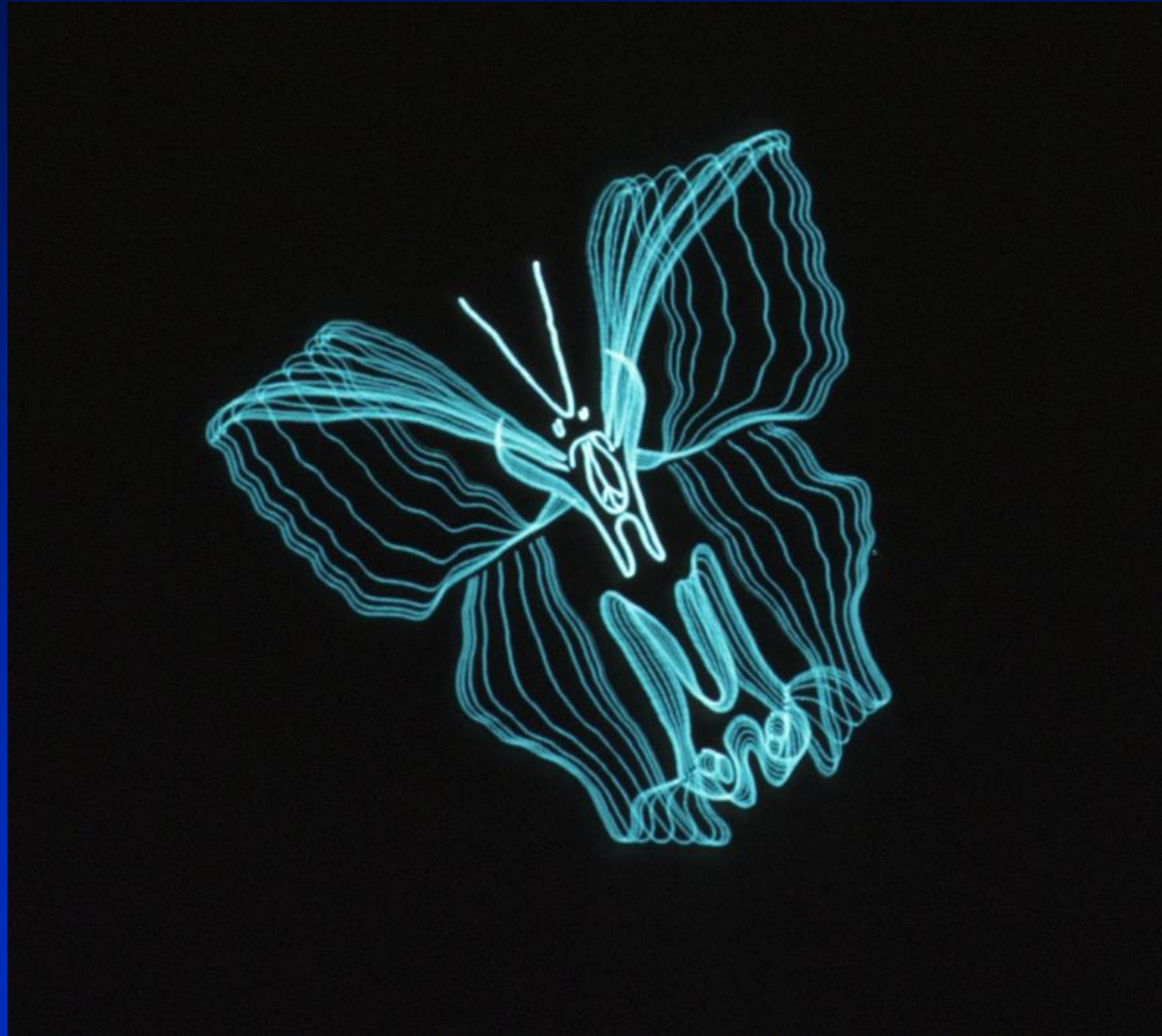
The Nereus Animation System



The Nereus Animation System



The Nereus Animation System



The Nereus Animation System

NEREUS PROGRAMS

EDITING COMMANDS SKETCH STROKE CAMERA END TIMING SCENES FLICKS IN/OUT COMMANDS

RESET ZOOM CLEAR LINEA VELOC ACCEL DISTANCE START END NUMBER OF DIVISIONS- 84 ELAPSED TIME

RESET BACKUP PANIC READ WRITE KILL MAP NPAGE DPAGE TORCH

← PAGE → ← PAGE →

CURRENT CONTENTS OF SCREEN ARE:

DATATYPE	SIZE	USED	# OF ENTRIES
SKETCH A	3840	1	0
SKETCH B	3840	1	0
TIMINGS	768	676	84

The Nereus Animation System

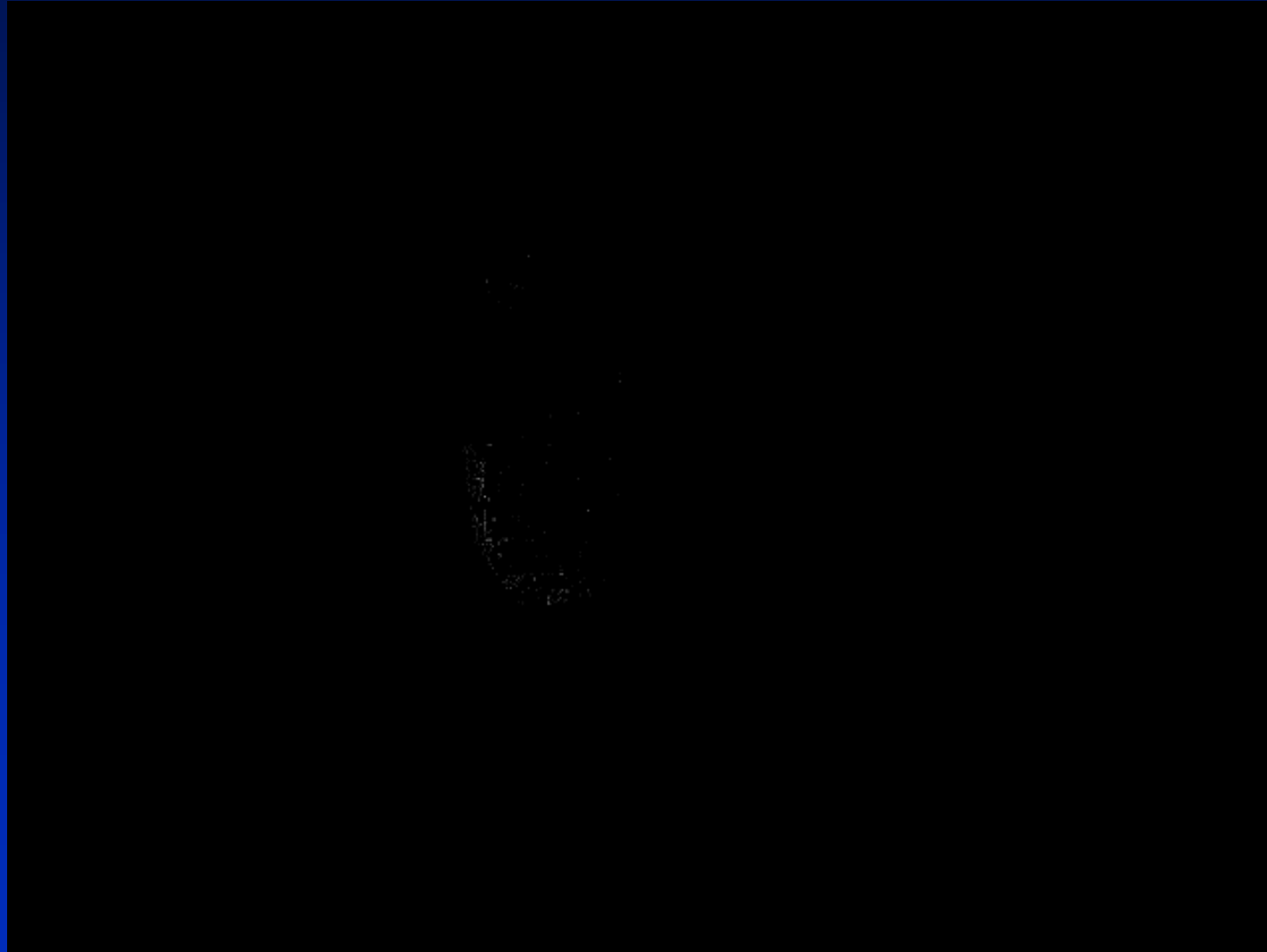


The Princess and The Frog

2009



Video – Princess Kissing the Frog



Approximate Employee Distribution

• Storyboard/Screen Writers	5
• Background	10
• Animators (140)	
– Key	25
– Ass't	40
– In-betweeners	75
• Checkers	10
• Inking/Painting	220
• Sound/Music	5
• Editing	10
	<hr/>
	Total 400

Partial automation

- Backgrounds can be drawn and colored on a computer
- **Key frames are still drawn by key animator**
- **All in-between frames are still drawn by animators**
- Cels can be inked and painted on a computer
- Cel and background can be put together and checked with a computer and then filmed

Advantages of Partial Animation

- All artistic control stays with the animators
- The cost of the most expensive part of the production process (inking and painting) is vastly reduced (1/10th)
- Can still take advantage of special features
 - > Zooming
 - > Color changes
 - > Multi-Plane camera simulation
 - > Reduction in scale

The Flintstones

H-B



The Flintstones

H-B



The Flintstones

H-B







Difficulties with 2D Animation

- Once you have produced sequences it is hard to change
- With 3D the story can change later in the process
- With 3D the character information is ready for sequels
- Can 3D serve as the basis for 2D?

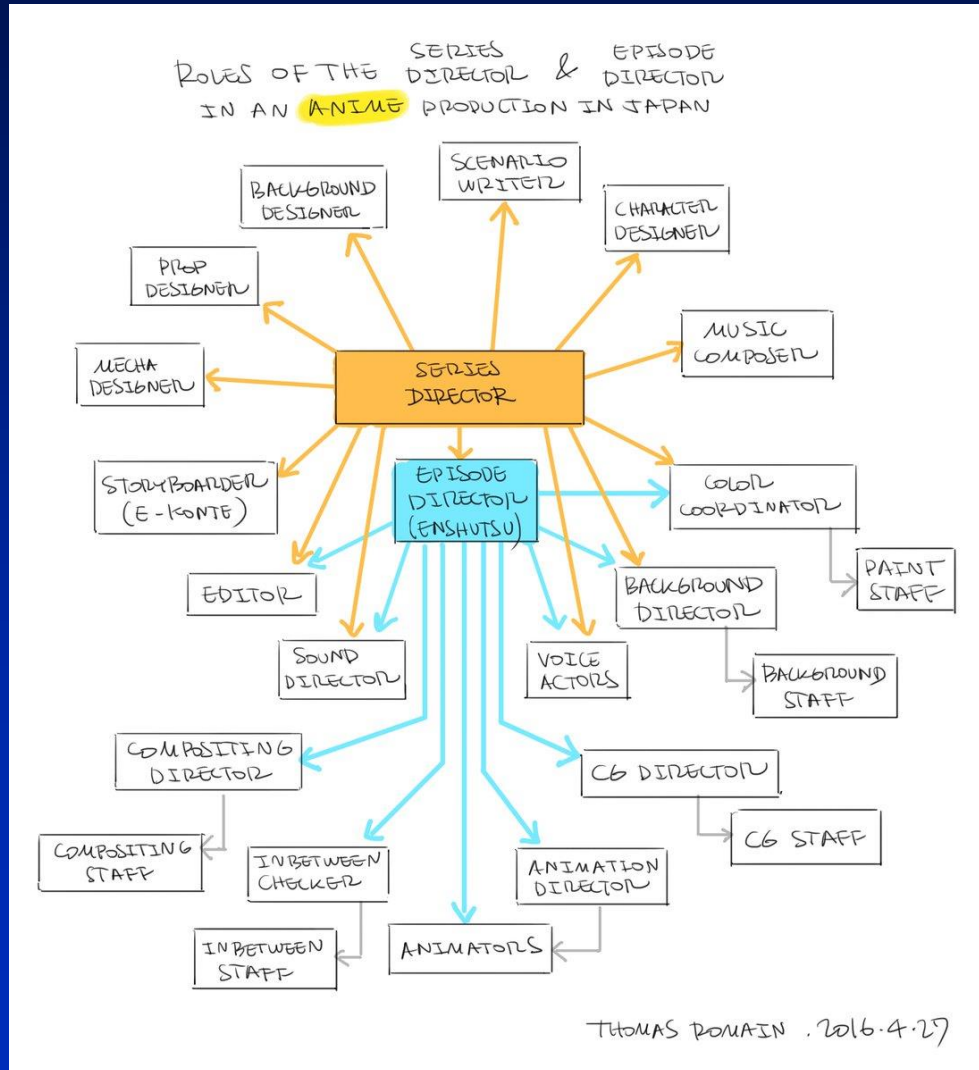
Japanese Anime



Anime Images



Animation Salaries are Depressing



Animation director: \$52K/year

Animation producer: \$50K/year

Animator: \$36K/year

Winnie the Pooh

Disney 2011



Domestic: \$27M

Foreign: \$6M

The Princess and the Frog

Disney 2013



Domestic: \$104M

Foreign: \$162M

No More Hand Drawn Animation

3/7/13



Disney
Bob Iger, CEO

END
