

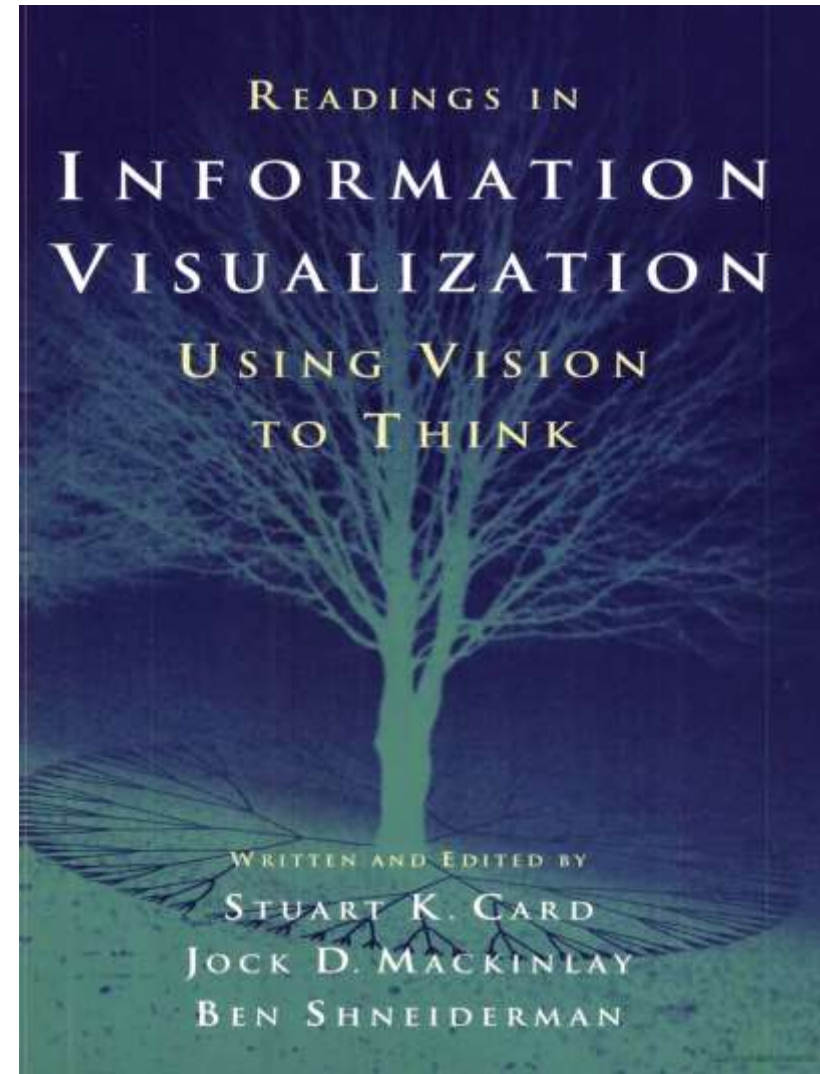
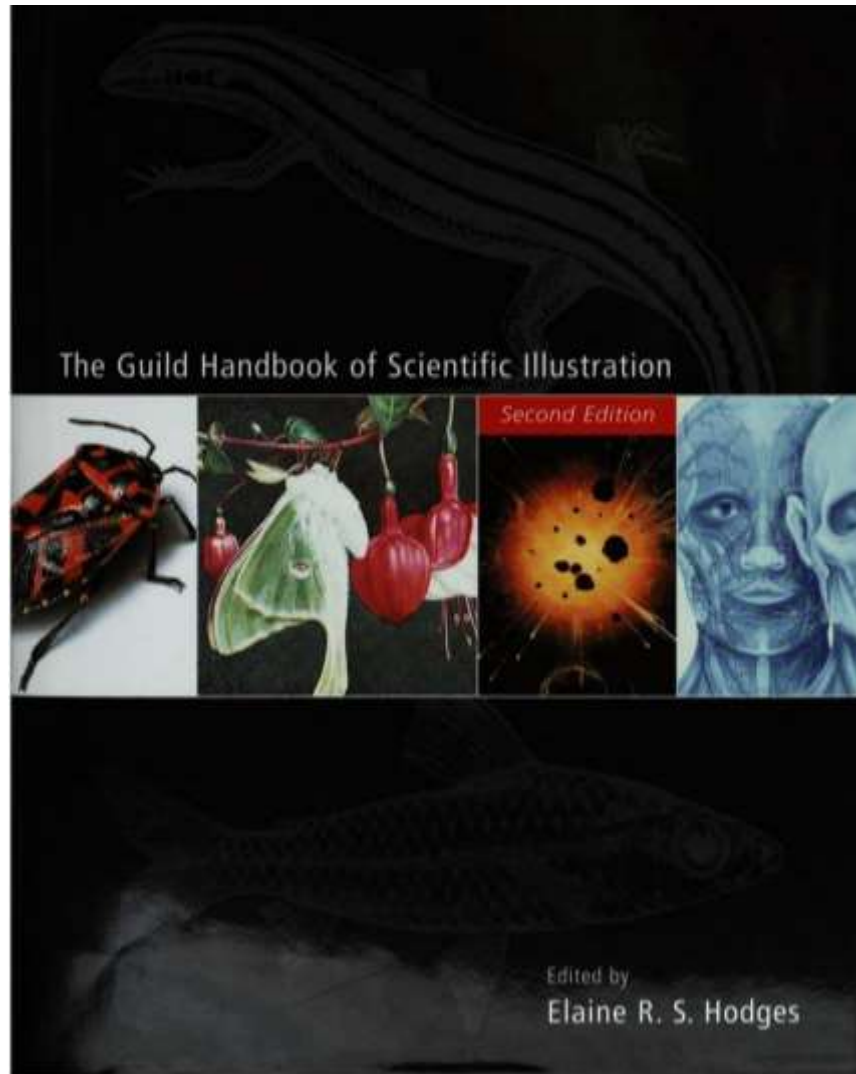


TOBIAS ISENBERG

*Illustrative*

**VISUALIZATION**

# ILLUSTRATION + VISUALIZATION



# ILLUSTRATION + VISUALIZATION

“Scientific illustration takes the viewer to the often unobservable – from molecules and viruses to the universe, from depiction of the internal anatomy of arthropods and plants to geologic cross sections and reconstruction of extinct life forms, from realistic to abstract portrayal.”

- *The Guild Handbook of Scientific Illustration*, 2003

“The use of computer-generated, interactive, visual representations of [...] data to amplify cognition.”

-*Card, Mackinlay, Shneiderman, 1999*

# ILLUSTRATION + VISUALIZATION

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“The use of computer-generated, interactive, visual representations of [...] data to amplify cognition.”

-*Card, Mackinlay, Shneiderman, 1999*

**WHY** *Illustration?*

# ILLUSTRATION CAN ...

PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE

PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE



AUDOBON, BLUE JAYS

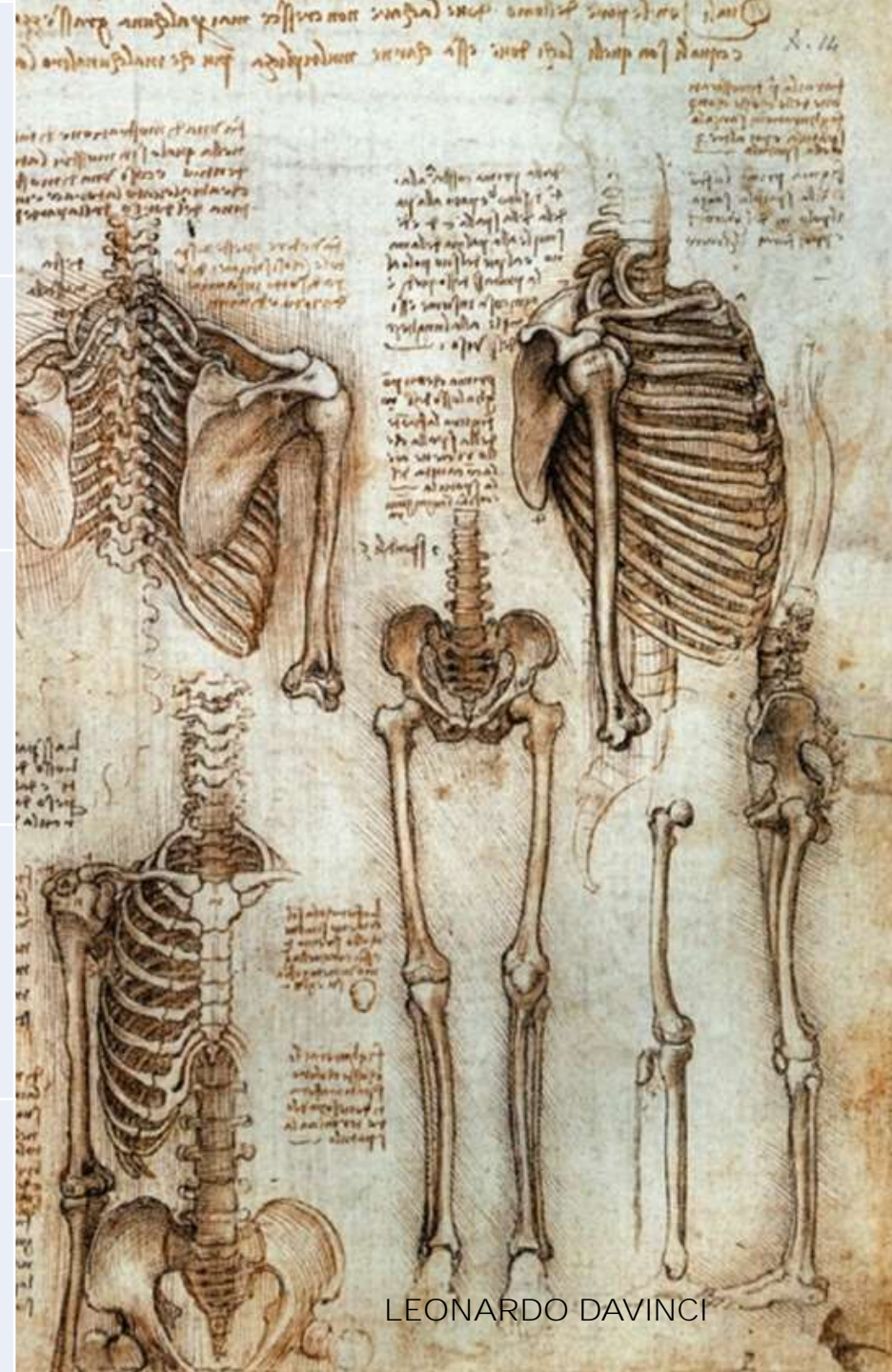
PIQUE INTEREST

REVEAL HIDDEN FEATURES

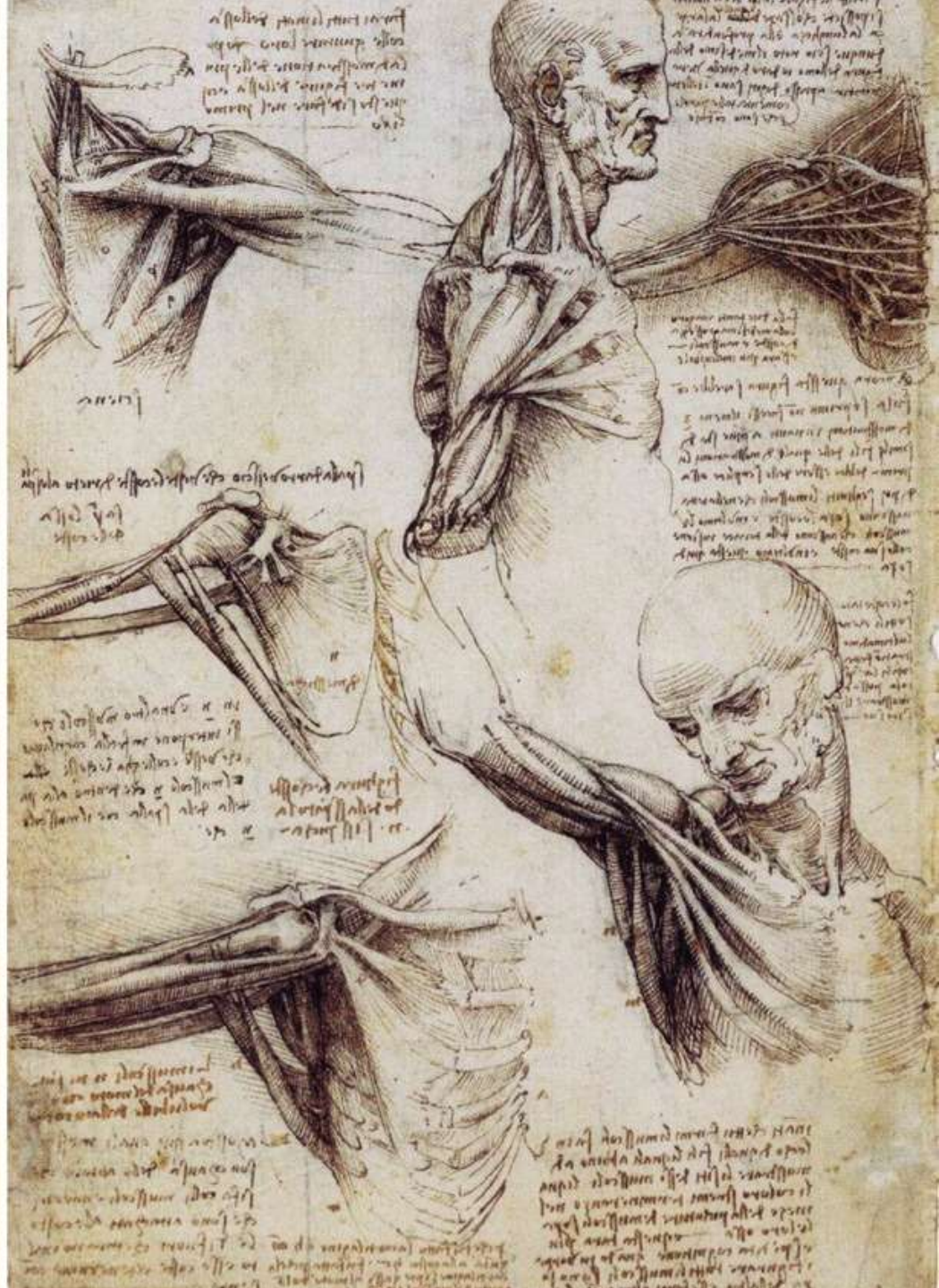
SHOW THE IMPOSSIBLE

TELL A STORY

SYNTHESIZE



LEONARDO DAVINCI





PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE



BMW ISETTA

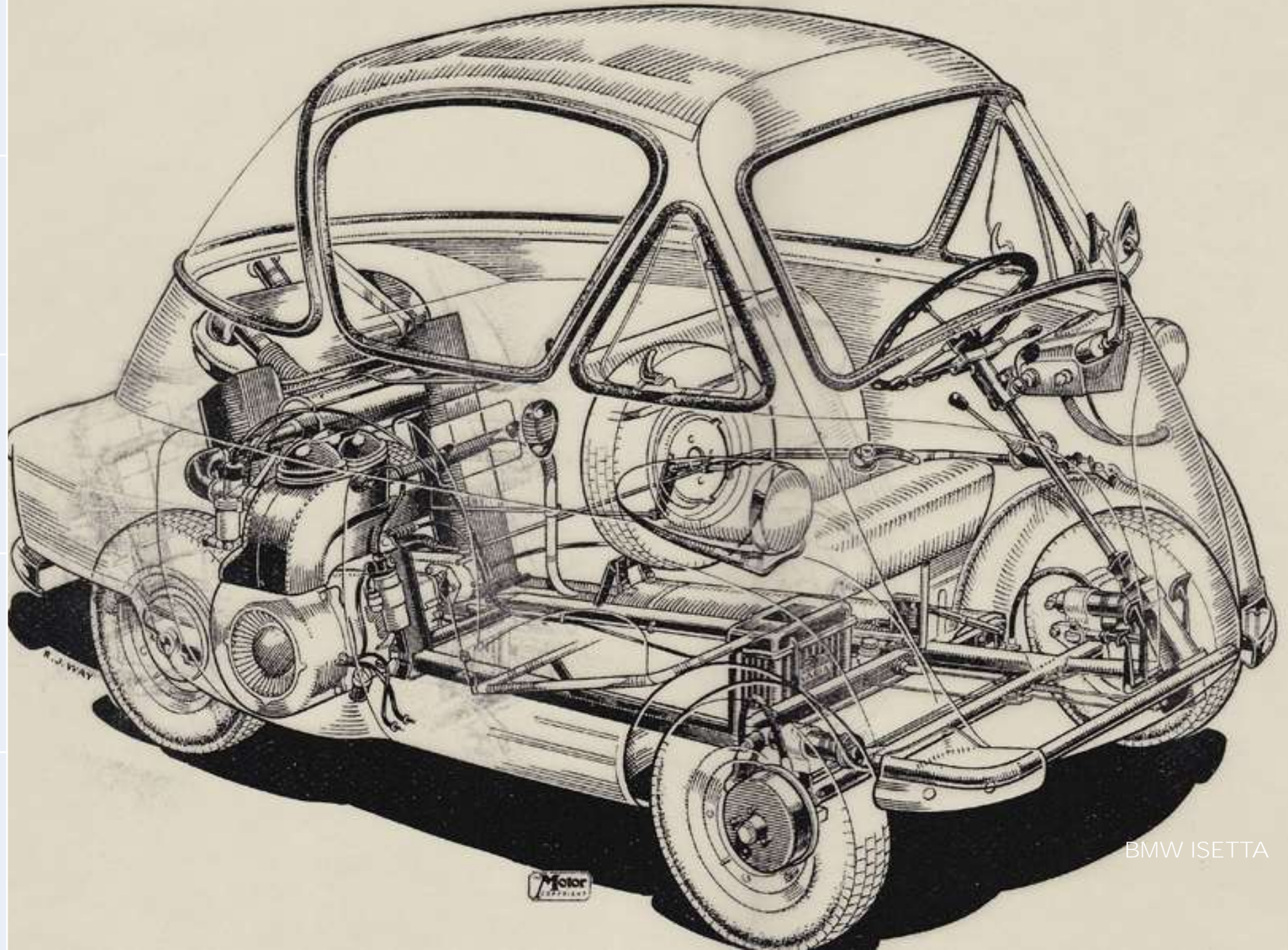
PIQUE INTEREST

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BMW ISETTA

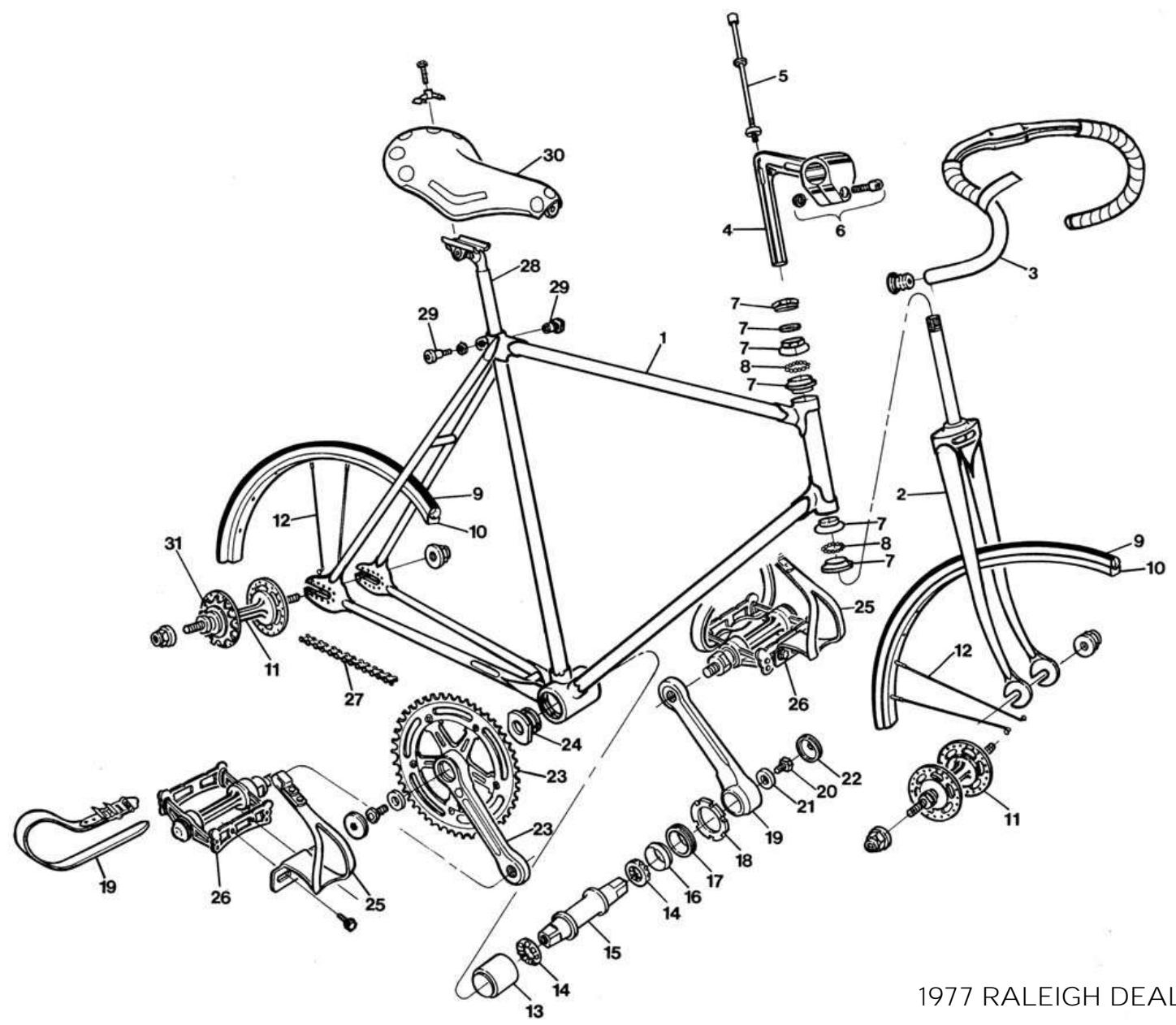
PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE



1977 RALEIGH DEALER MANUAL

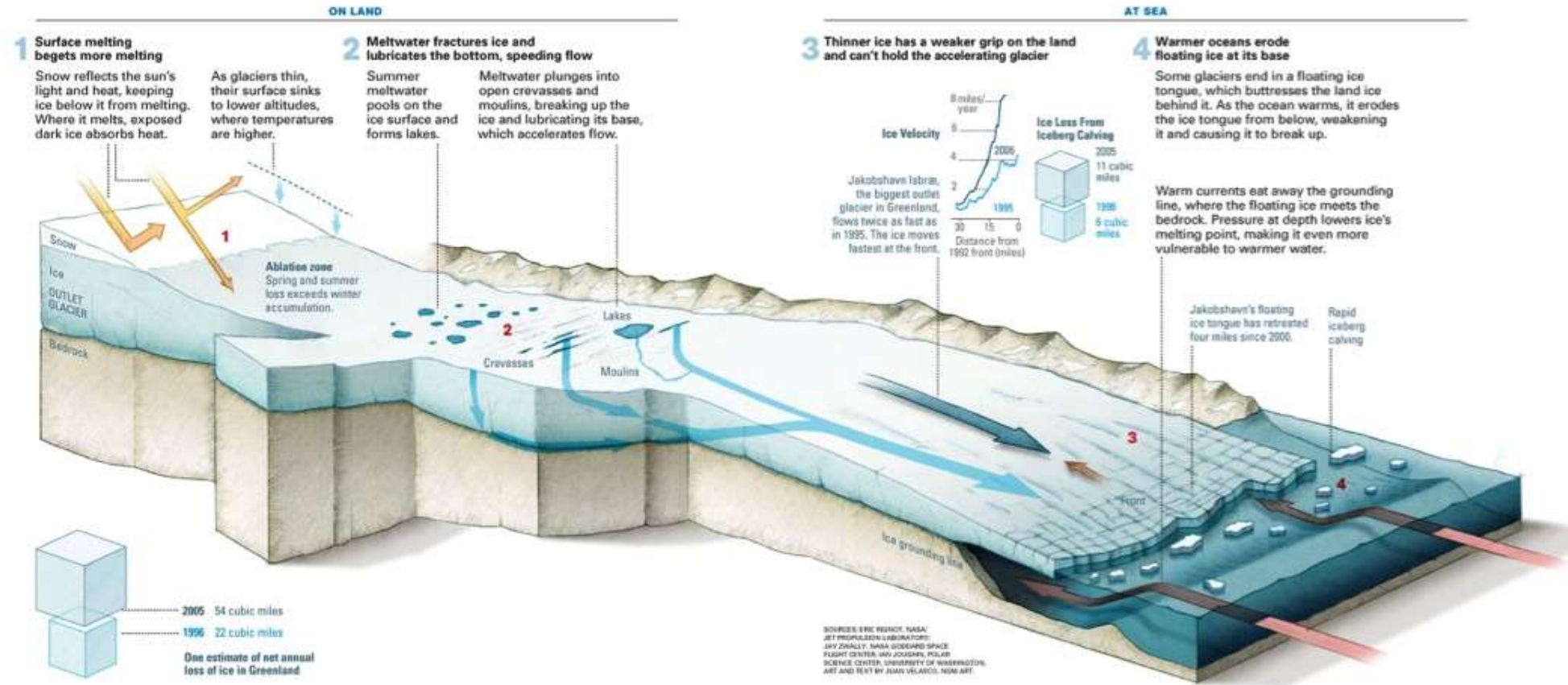
PIQUE INTEREST

REVEAL HIDDEN FEATURES

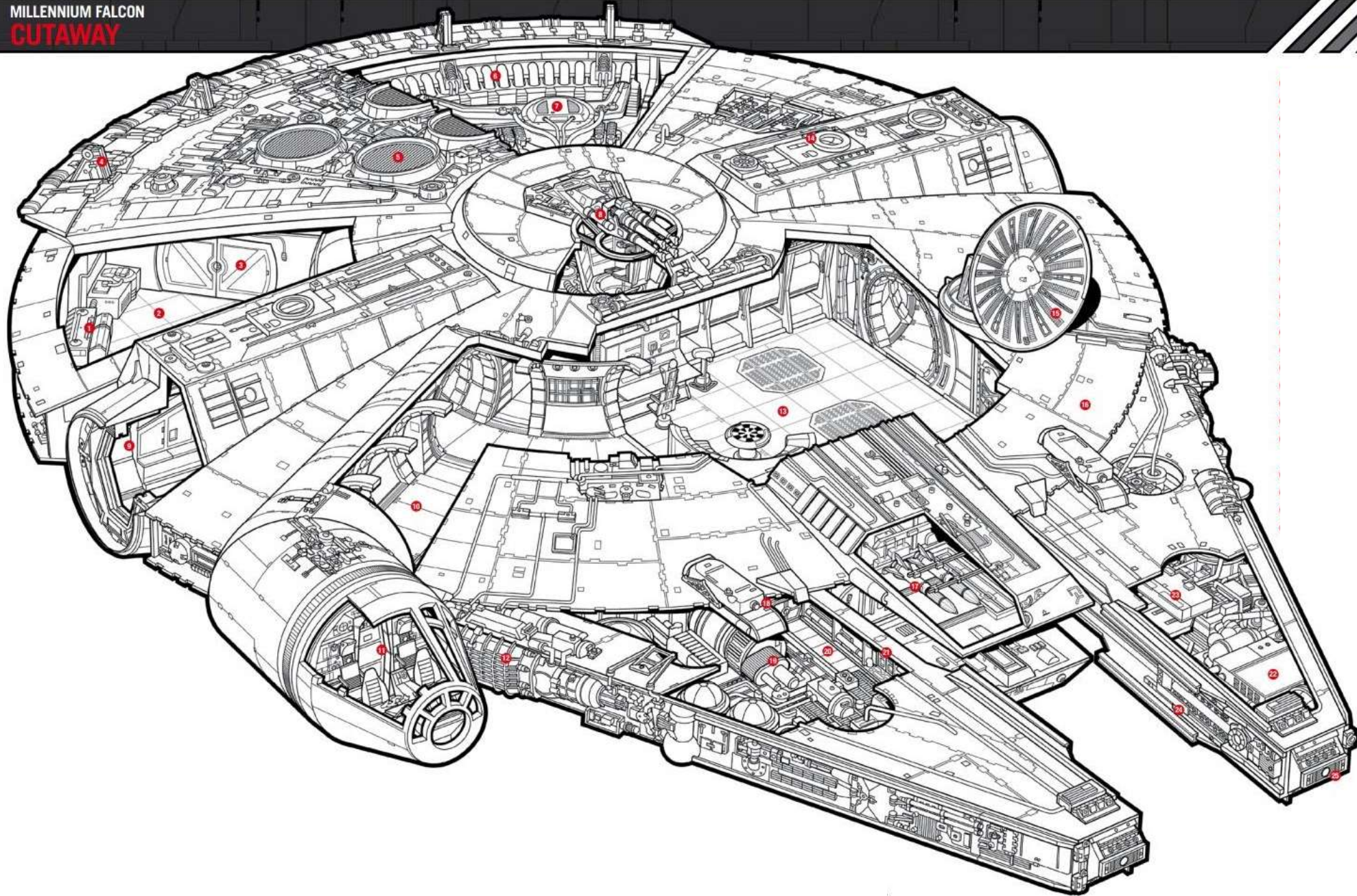
SHOW THE IMPOSSIBLE

TELL A STORY

SYNTHESIZE



MILLENNIUM FALCON  
CUTAWAY



PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE

**ILLUSTRATION CAN ...**

PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE

*... and more!*

**WHY Visualization?**

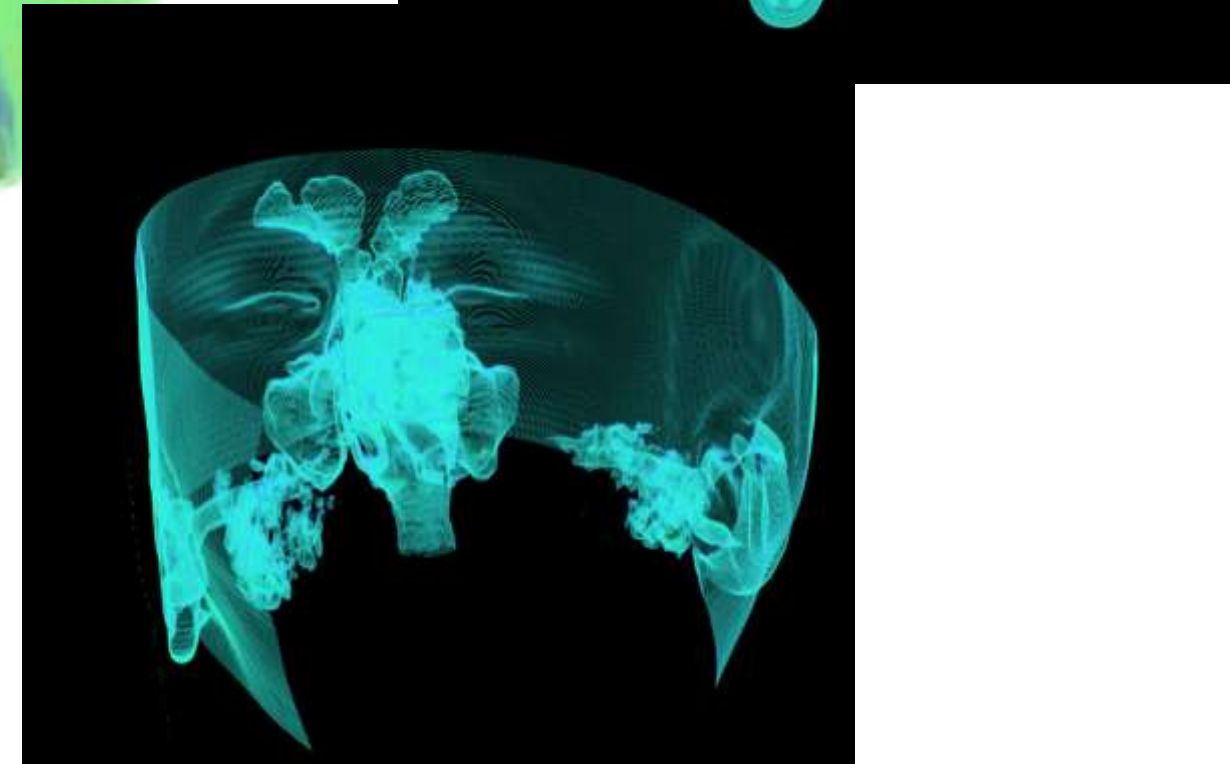
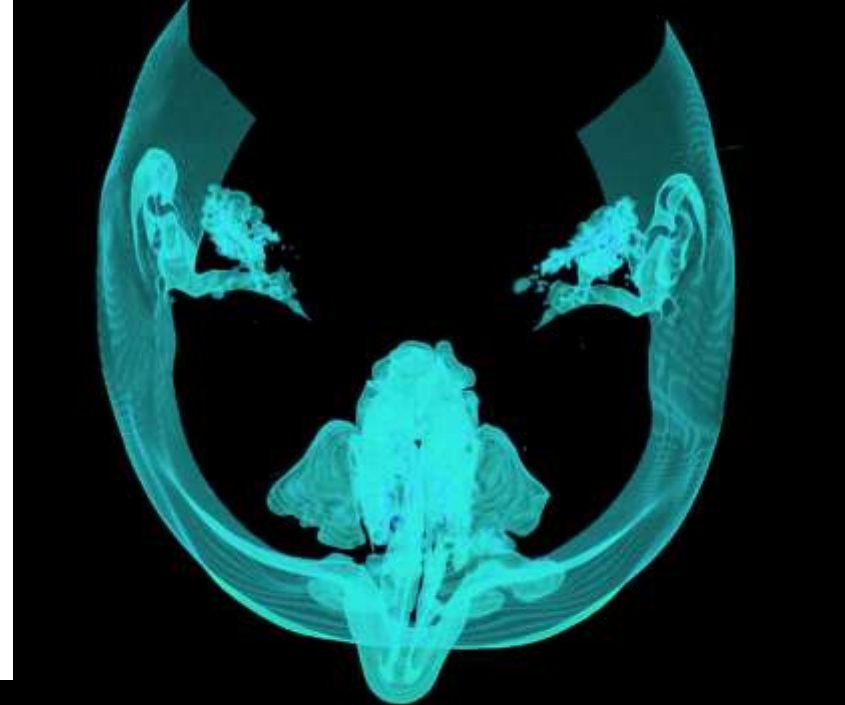
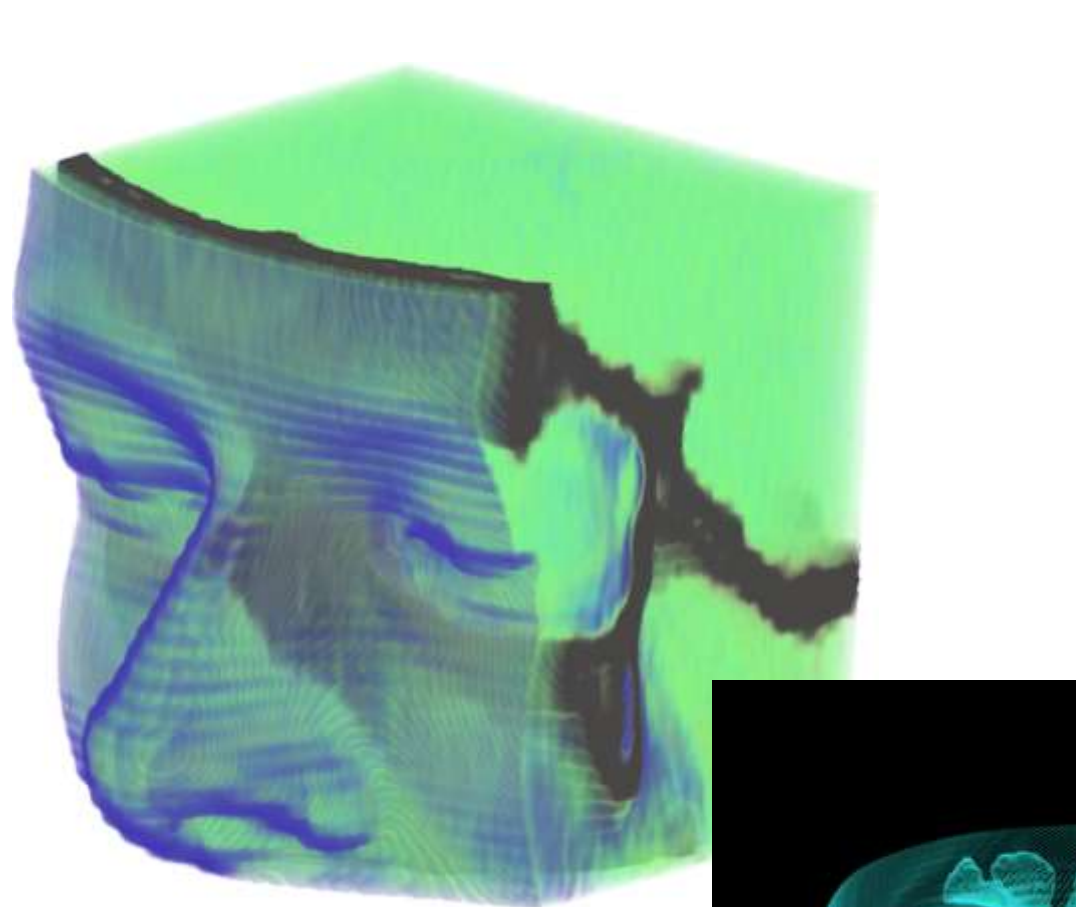
USE SPECIFIC DATA

BE GENERATED  
ON-DEMAND

BE EXPLORED  
INTERACTIVELY

SHOW CHANGES  
OVER TIME

COMBINE SEVERAL  
DATA SOURCES





USE SPECIFIC DATA

BE GENERATED  
ON-DEMAND

BE EXPLORED  
INTERACTIVELY

SHOW CHANGES  
OVER TIME

COMBINE SEVERAL  
DATA SOURCES



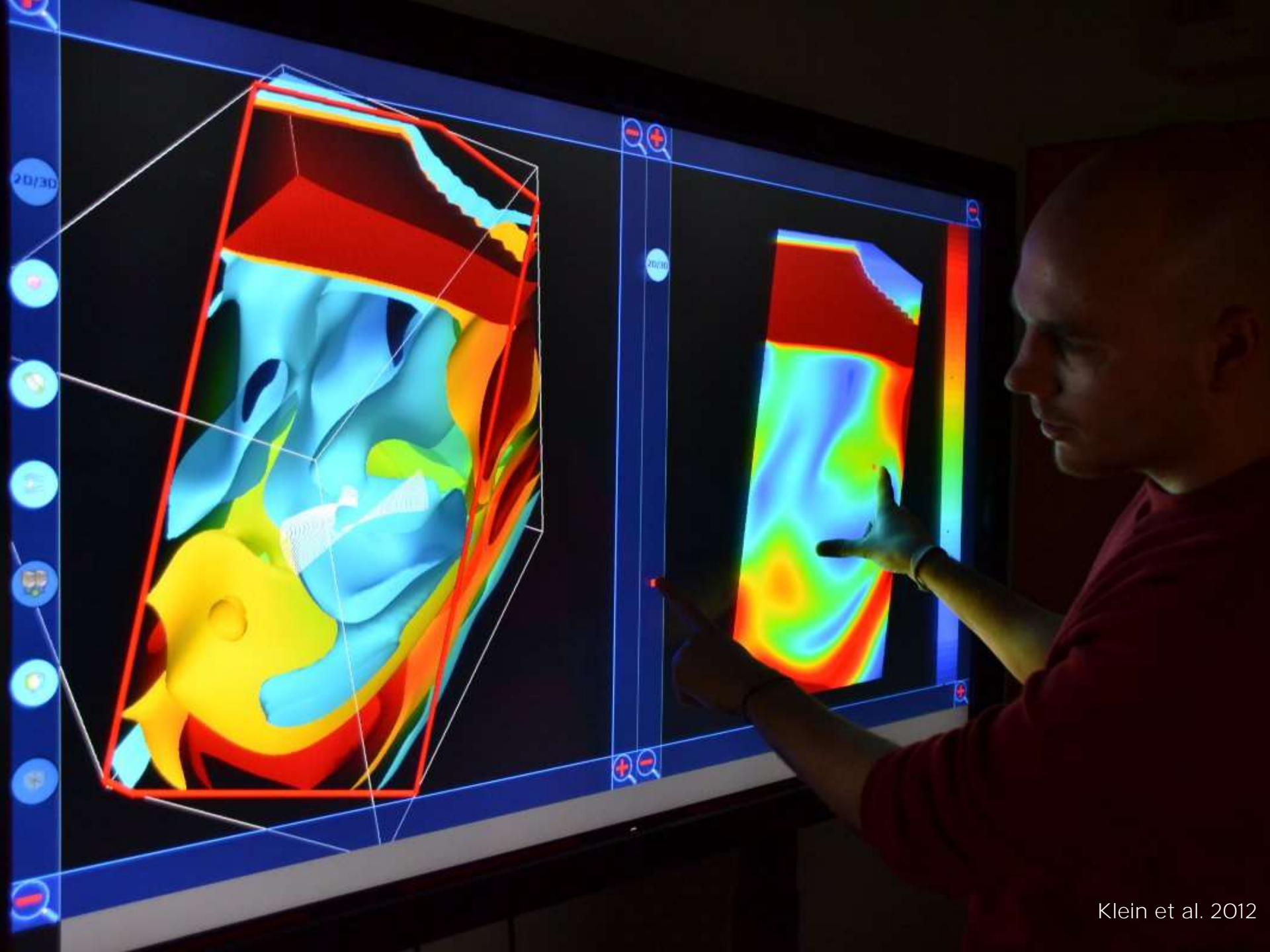
USE SPECIFIC DATA

BE GENERATED  
ON-DEMAND

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SHOW CHANGES  
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COMBINE SEVERAL  
DATA SOURCES

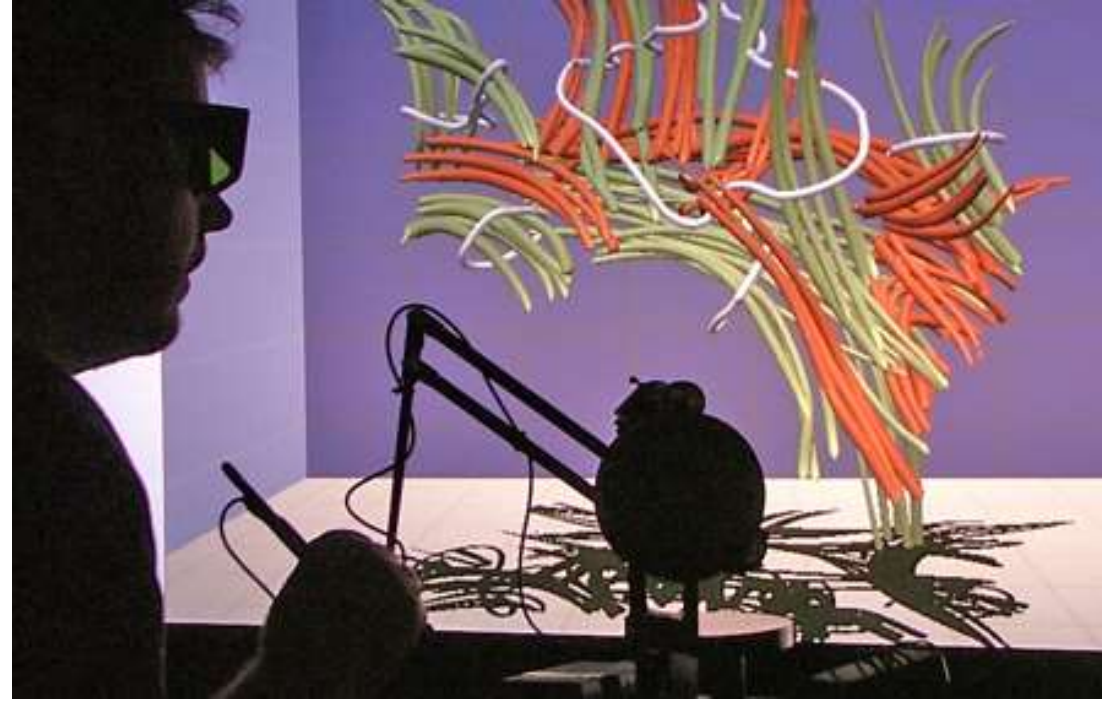


USE SPECIFIC DATA



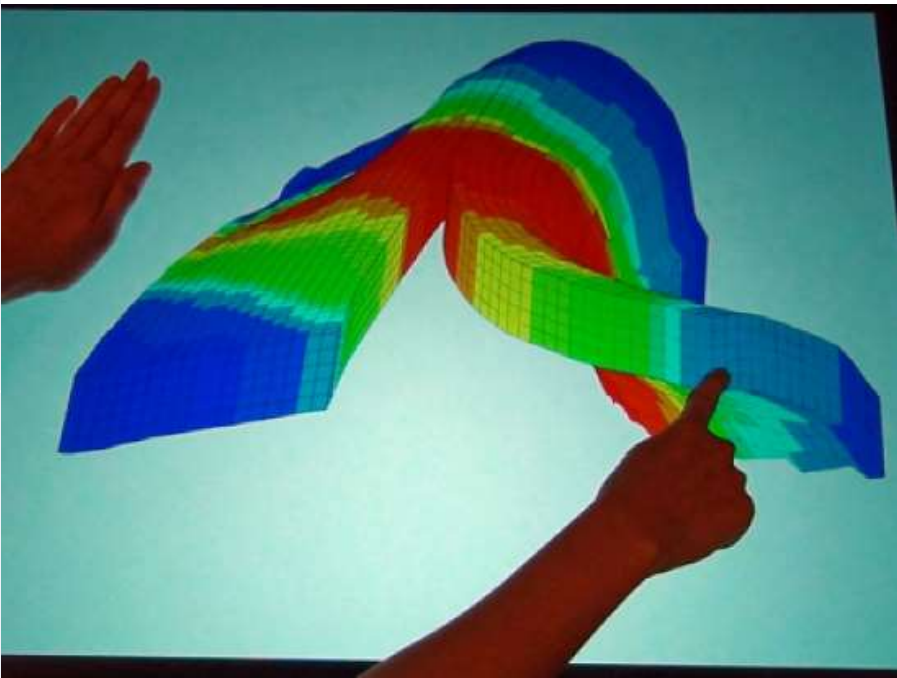
Univ. Groningen

BE GENERATED ON-DEMAND



Daniel F. Keefe

BE EXPLORED INTERACTIVELY



SHOW CHANGES OVER TIME

Sultanum et al. 2010/2011

COMBINE SEVERAL DATA SOURCES

Coffey et al. 2011/2012



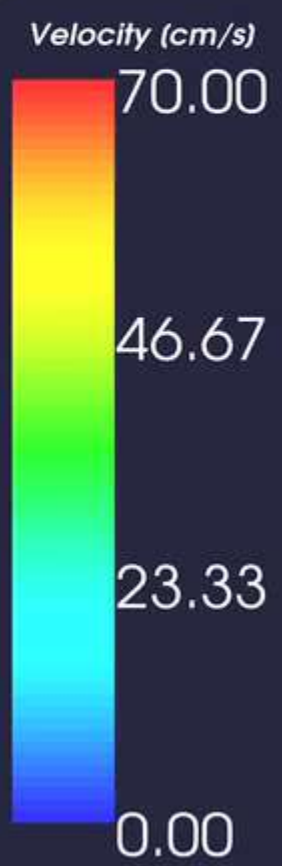
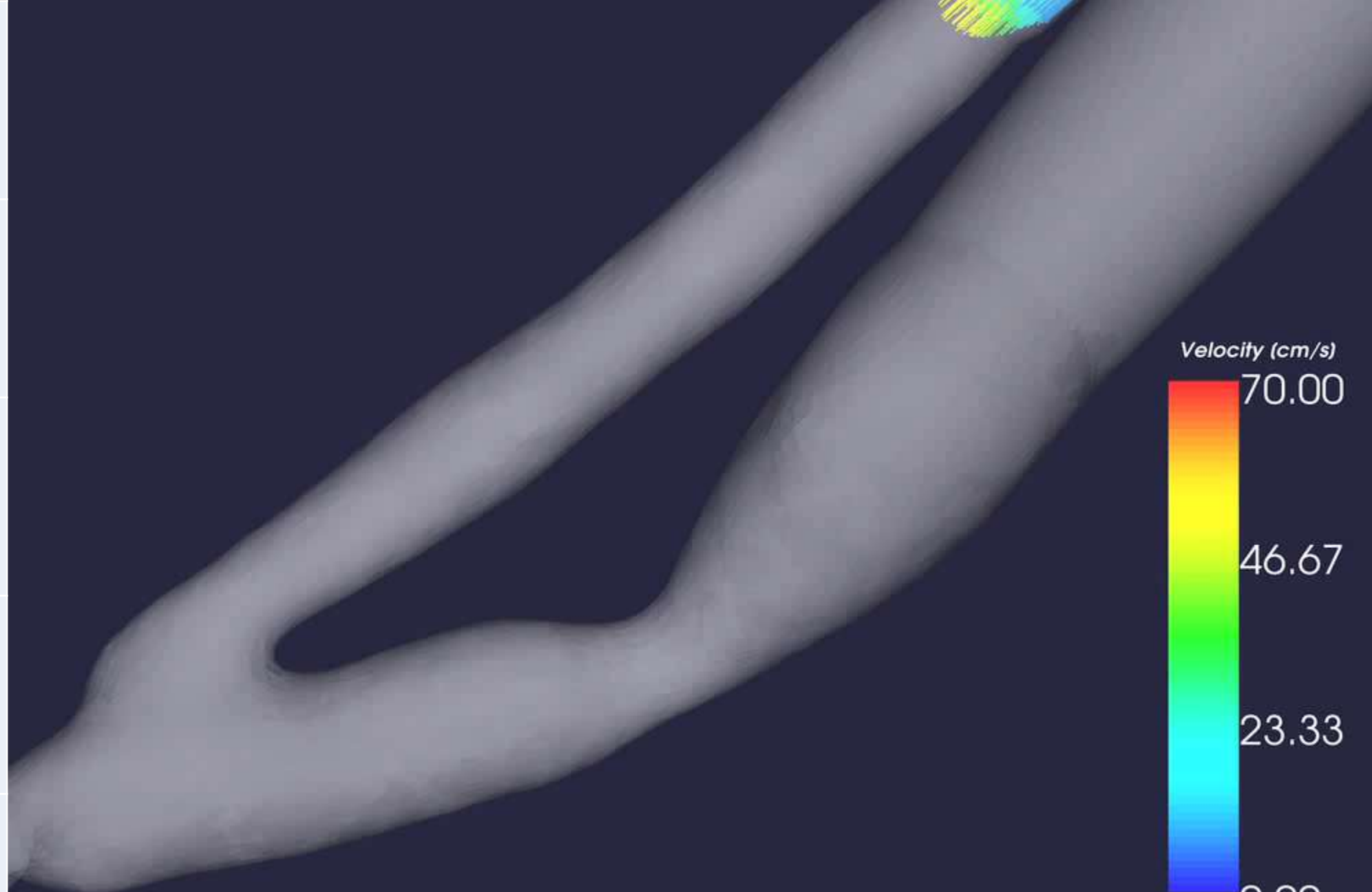
USE SPECIFIC DATA

BE GENERATED  
ON-DEMAND

BE EXPLORED  
INTERACTIVELY

SHOW CHANGES  
OVER TIME

COMBINE SEVERAL  
DATA SOURCES



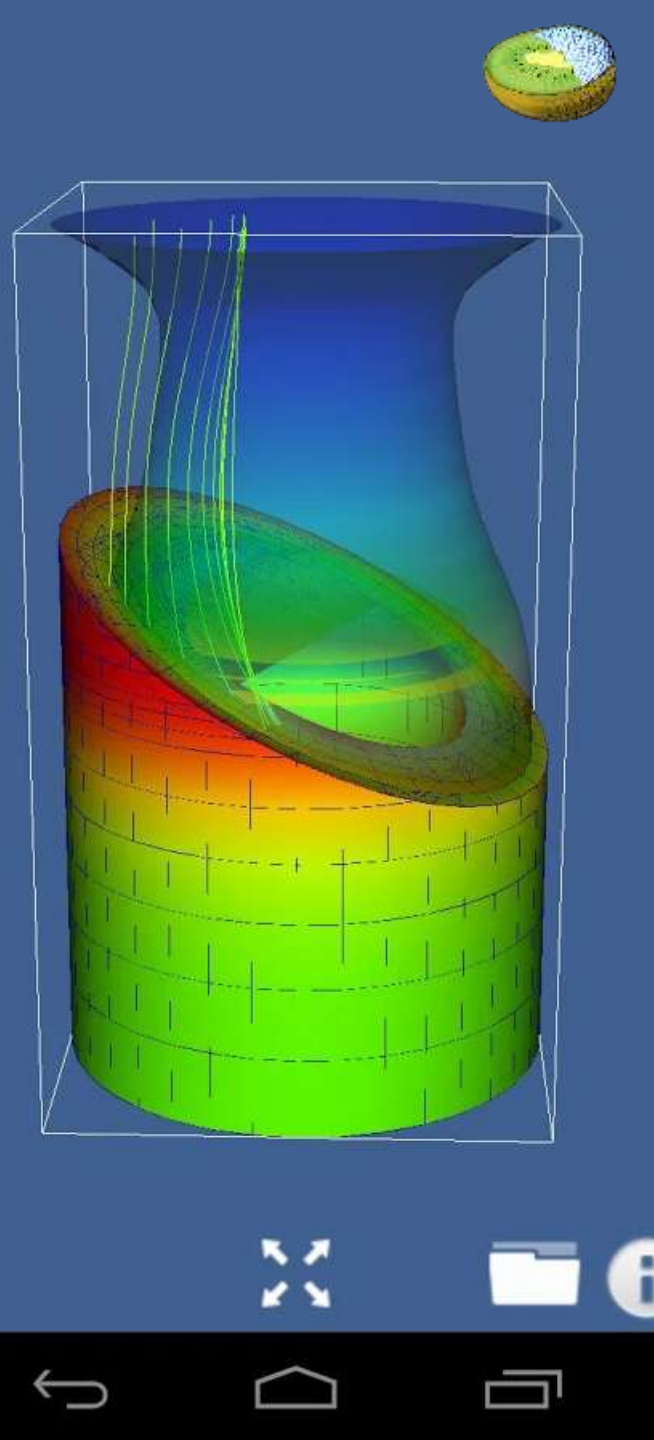
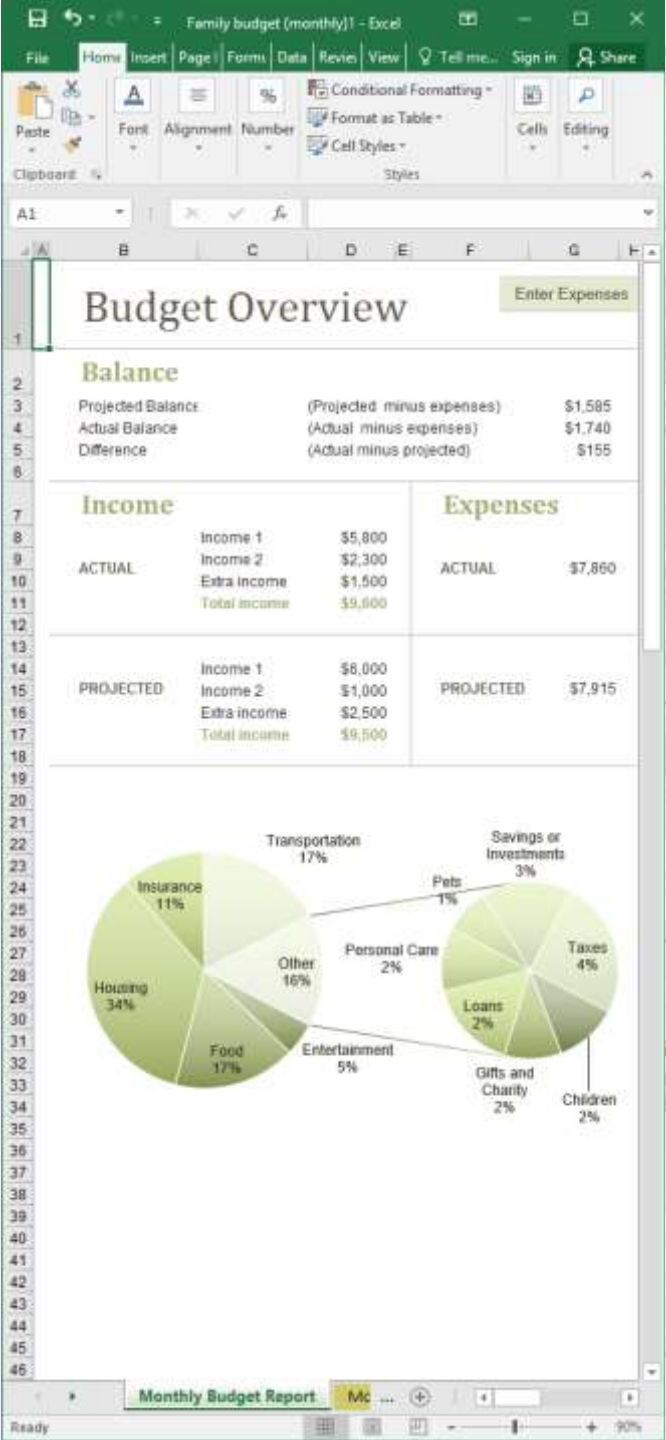
USE SPECIFIC DATA

BE GENERATED ON-DEMAND

BE EXPLORED INTERACTIVELY

SHOW CHANGES OVER TIME

BE CREATED BY NON-EXPERTS



USE SPECIFIC DATA

BE GENERATED  
ON-DEMAND

BE EXPLORED  
INTERACTIVELY

SHOW CHANGES  
OVER TIME

BE CREATED BY  
NON-EXPERTS

# *Illustrative* **VISUALIZATION**

PIQUE INTEREST

REVEAL HIDDEN  
FEATURES

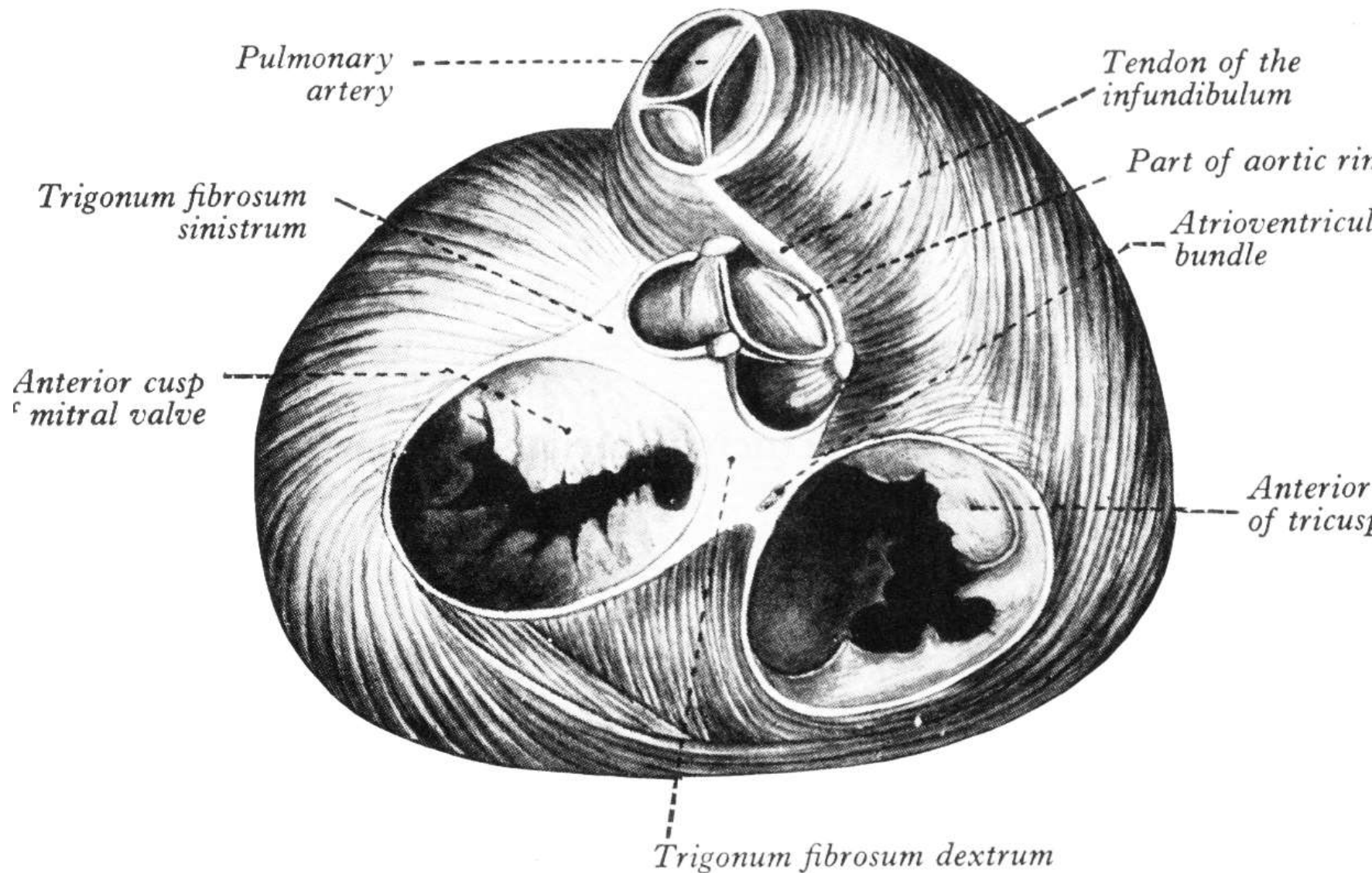
SHOW THE  
IMPOSSIBLE

TELL A STORY

SYNTHESIZE

*Elements* OF ILLUSTRATIVE  
VISUALIZATION

# Non-Photorealistic Rendering

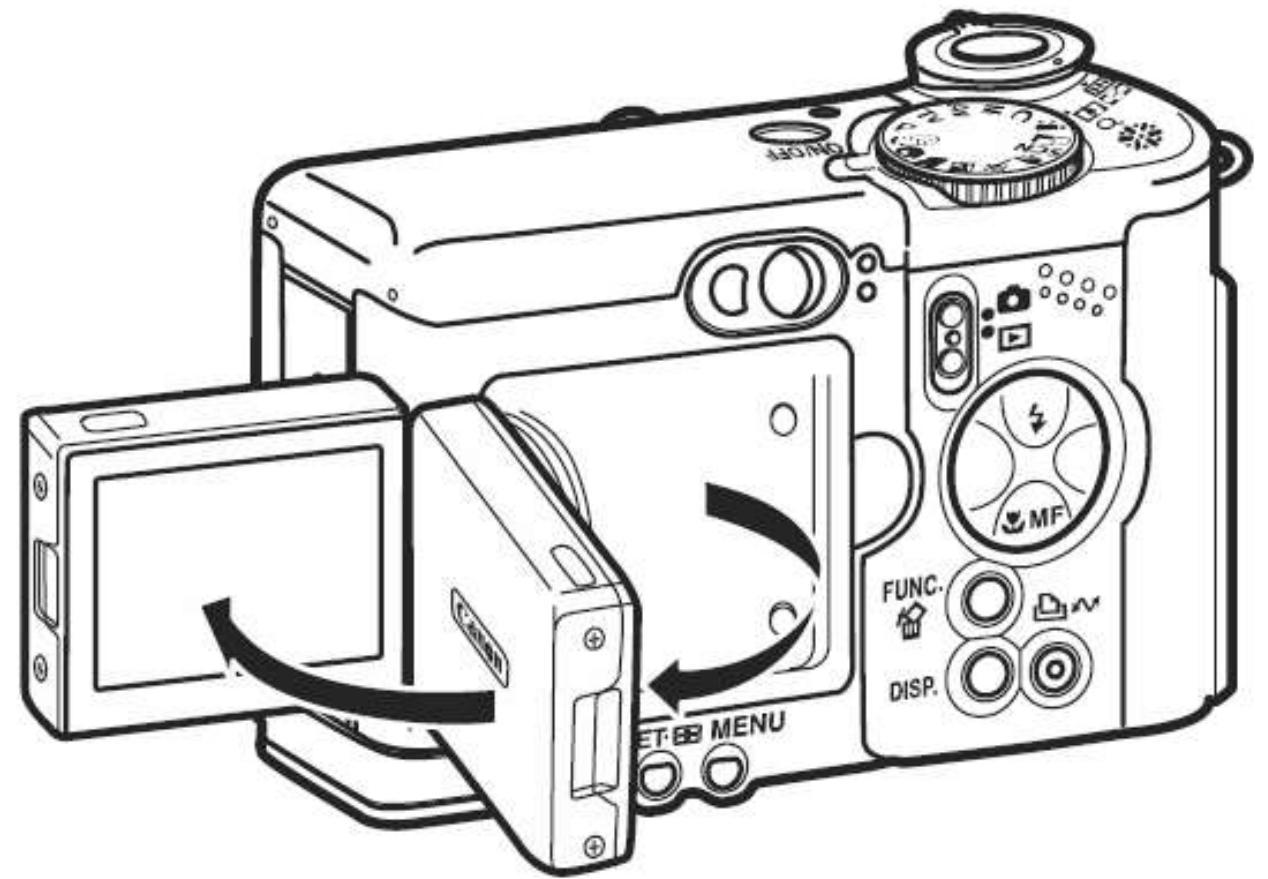




# SPARSE LINE DRAWINGS

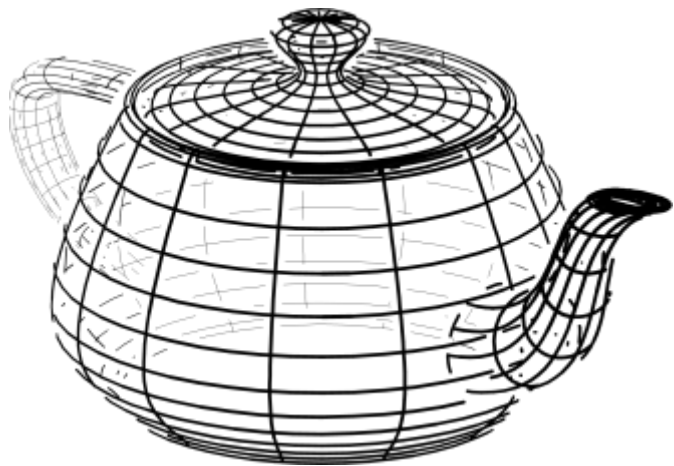


© WALT DISNEY

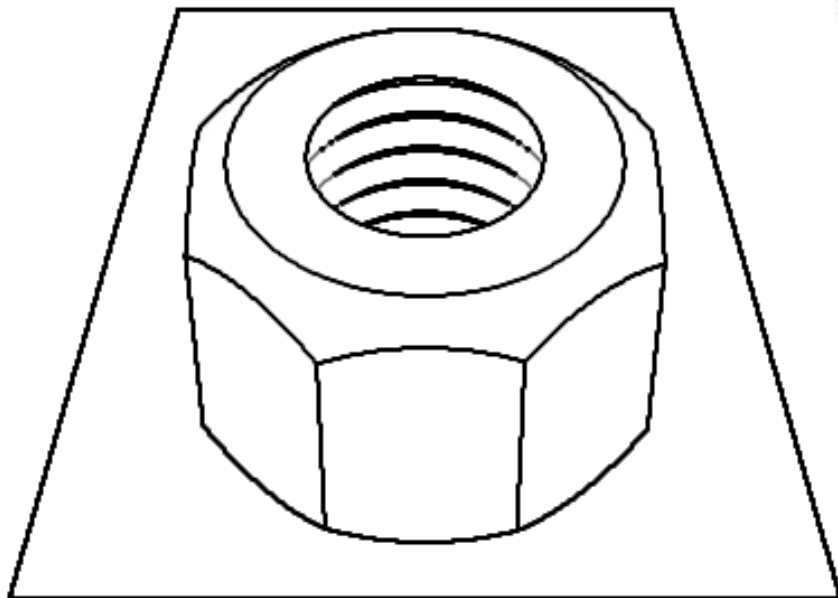


© Canon

# SPARSE LINE DRAWINGS



Elber, 1995

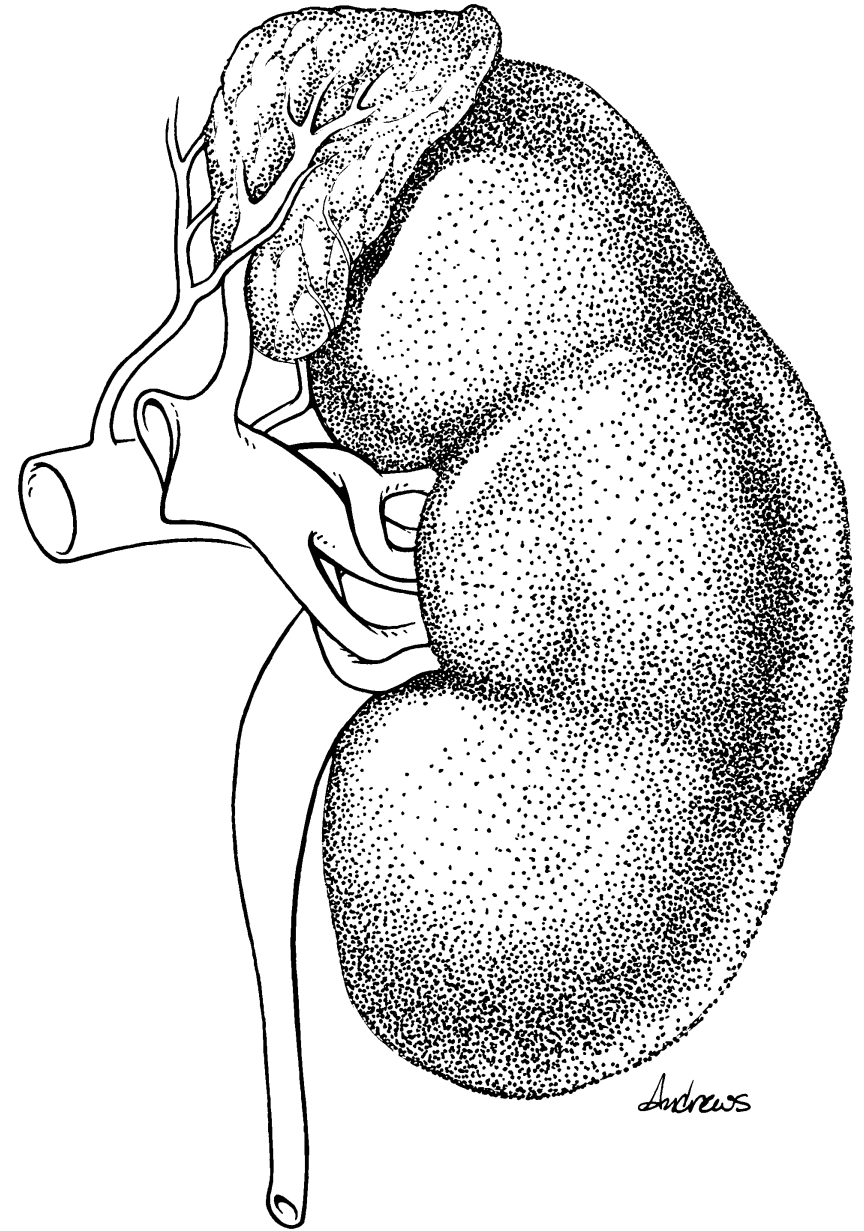
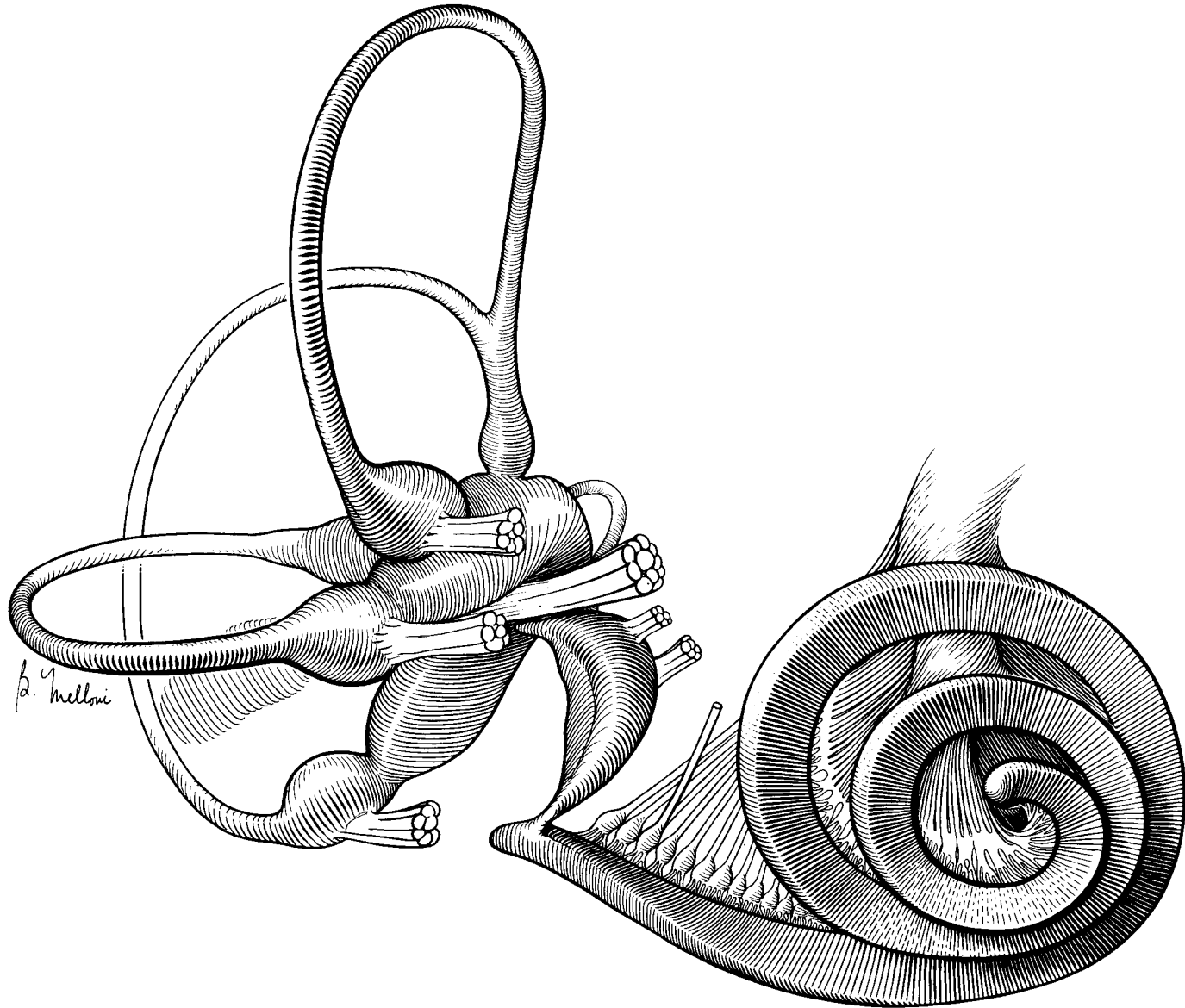


DeCarlo et al., 2003

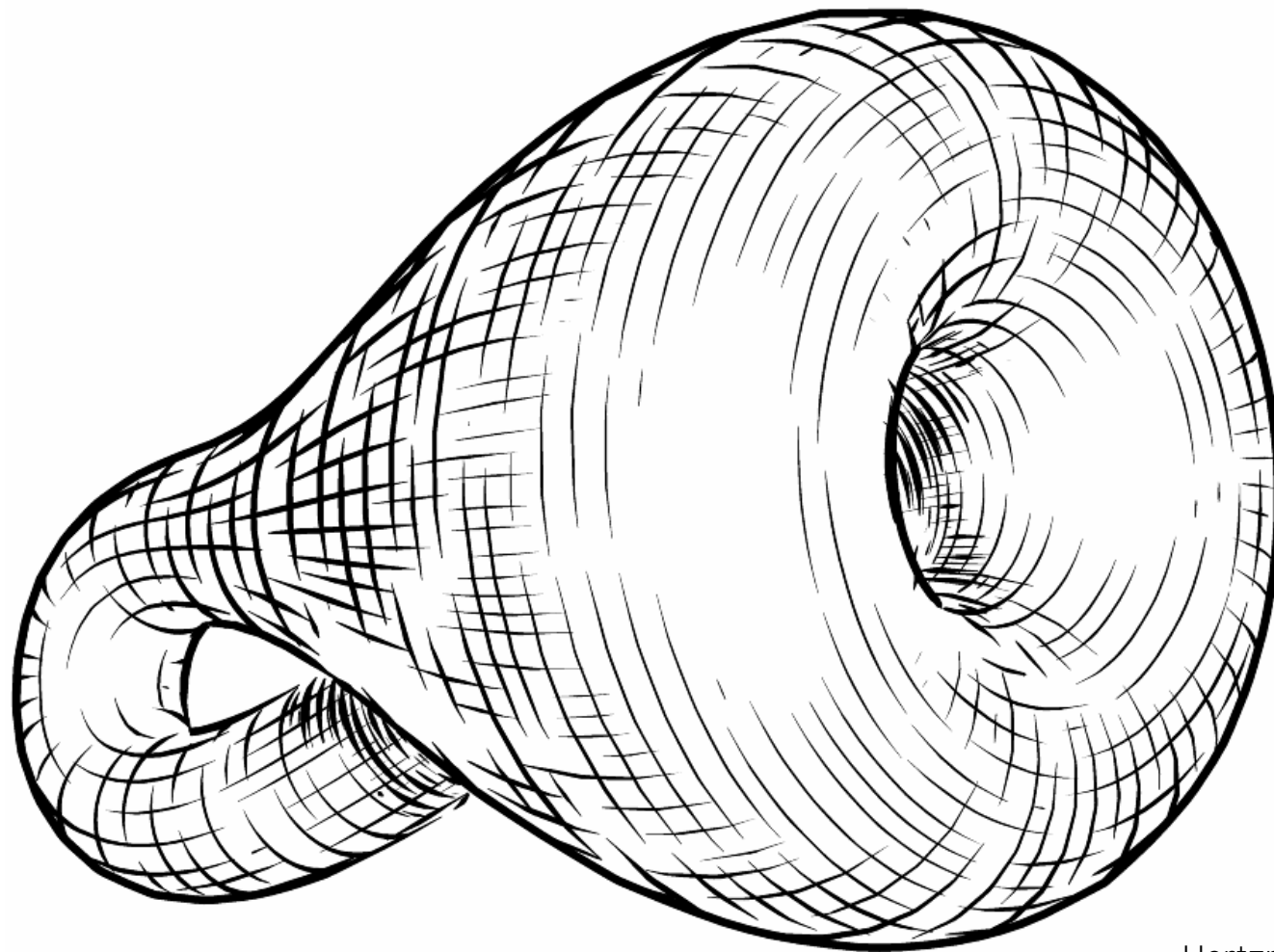


DeCarlo and  
Rusinkiewicz, 2007

# HATCHING & STIPPLING

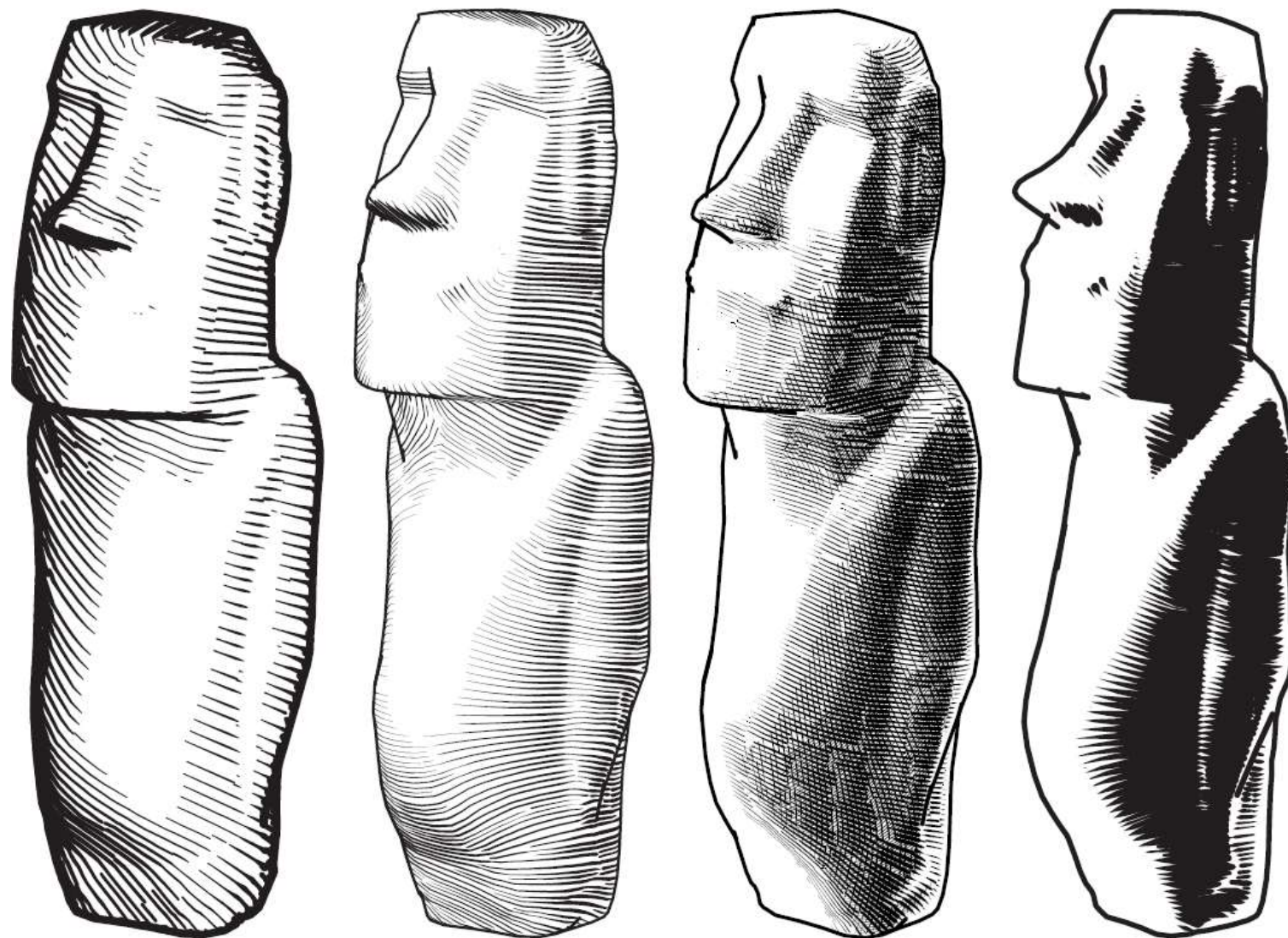


# HATCHING

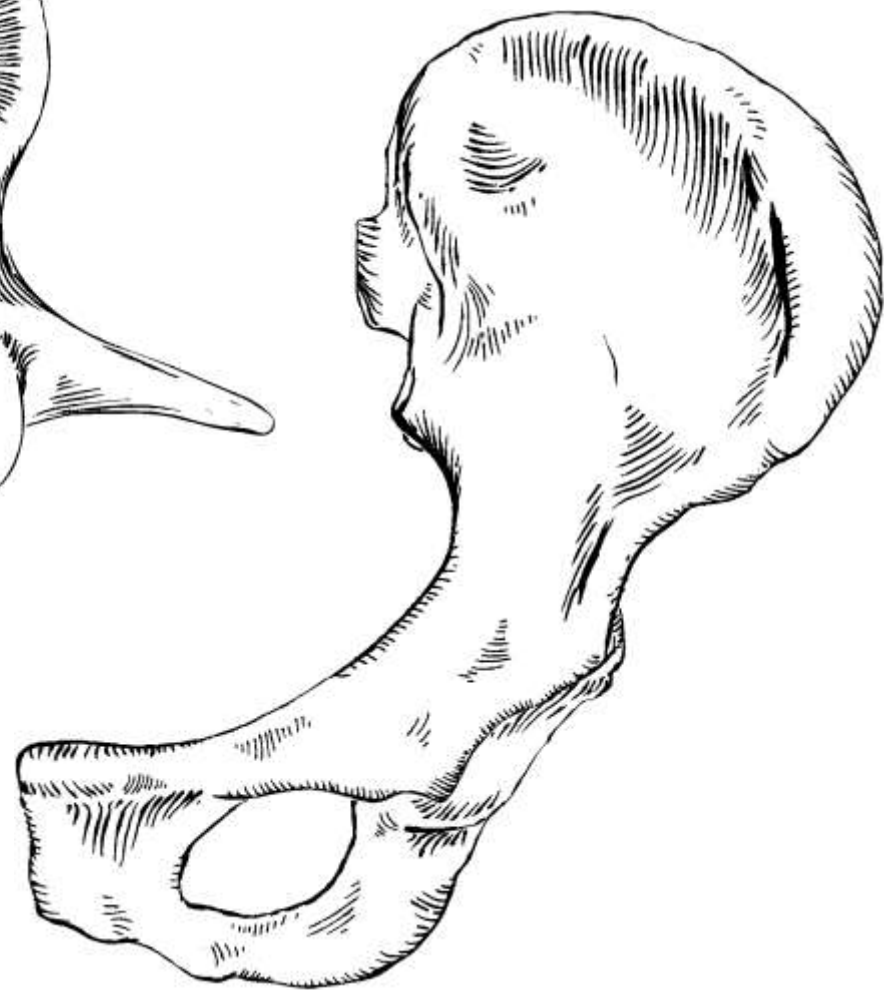
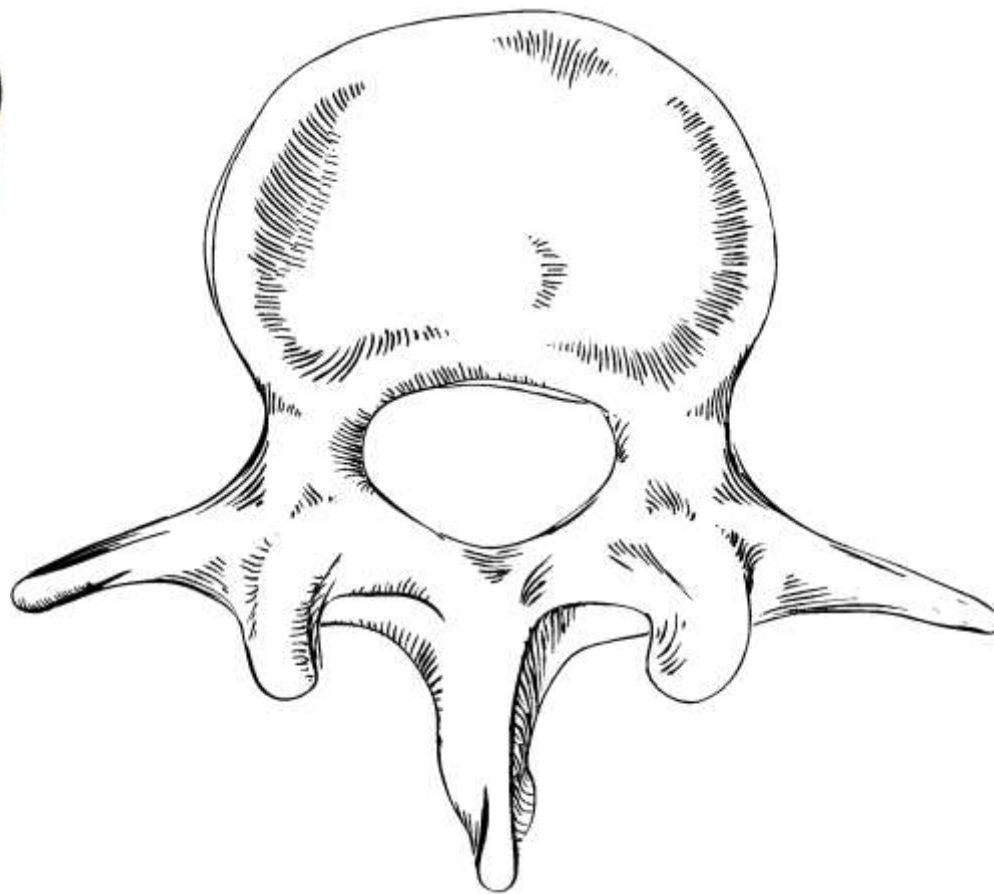


Hertzmann and Zorin, 2000

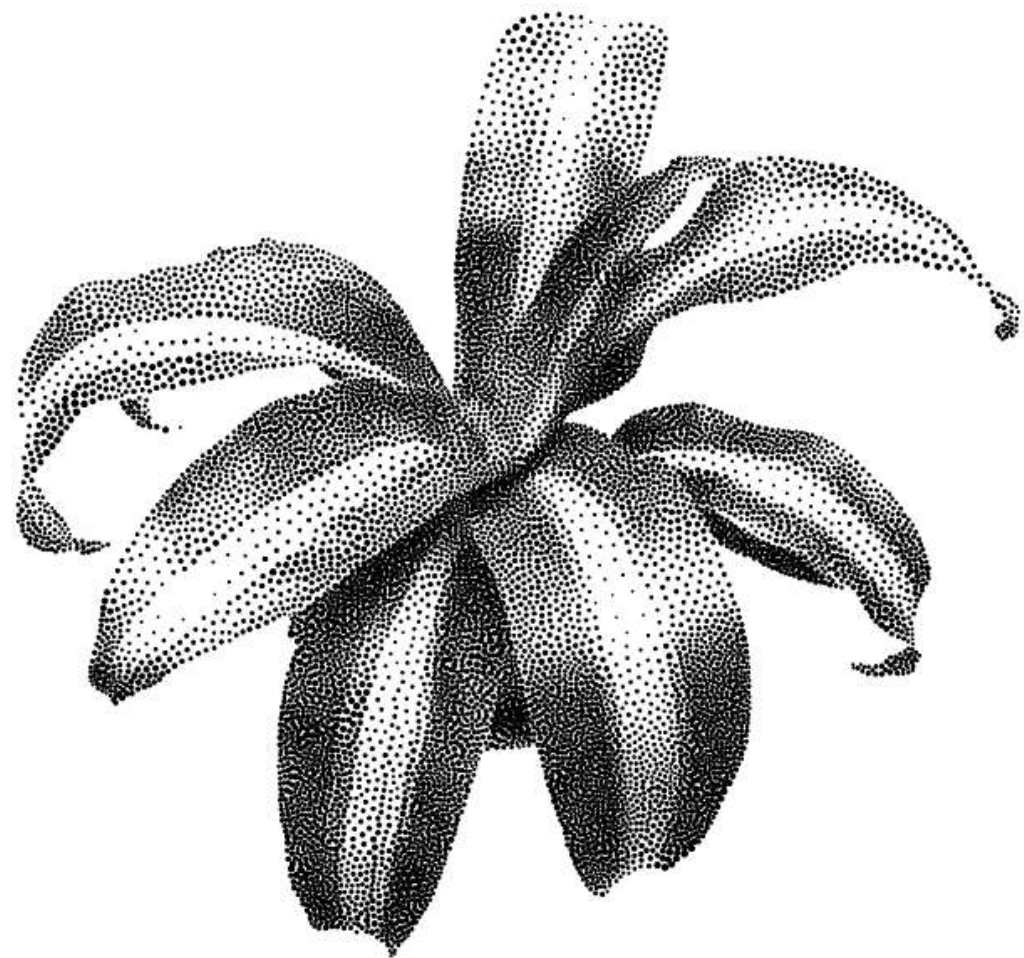
# HATCHING



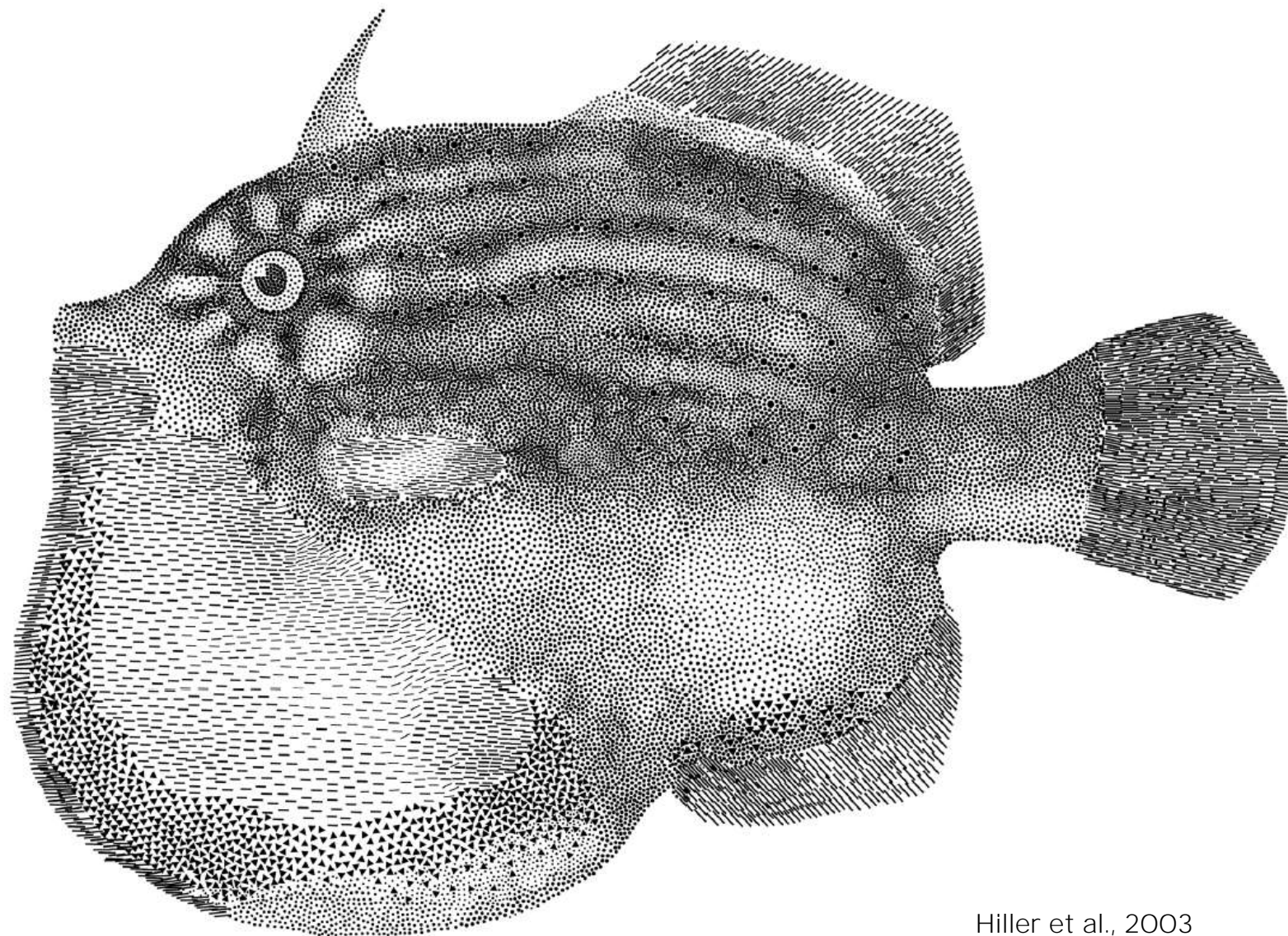
# HATCHING



# STIPPLING



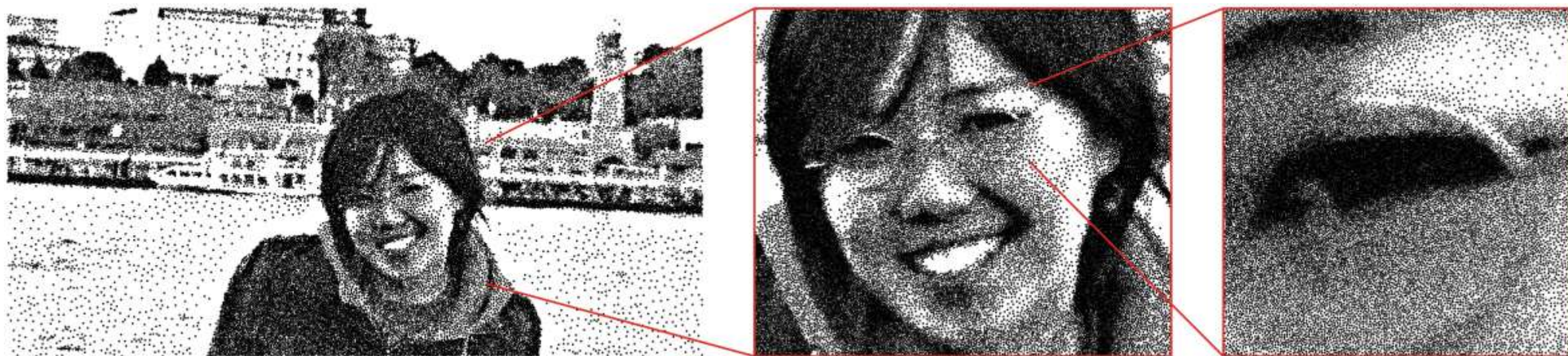
# STIPPLING



Hiller et al., 2003

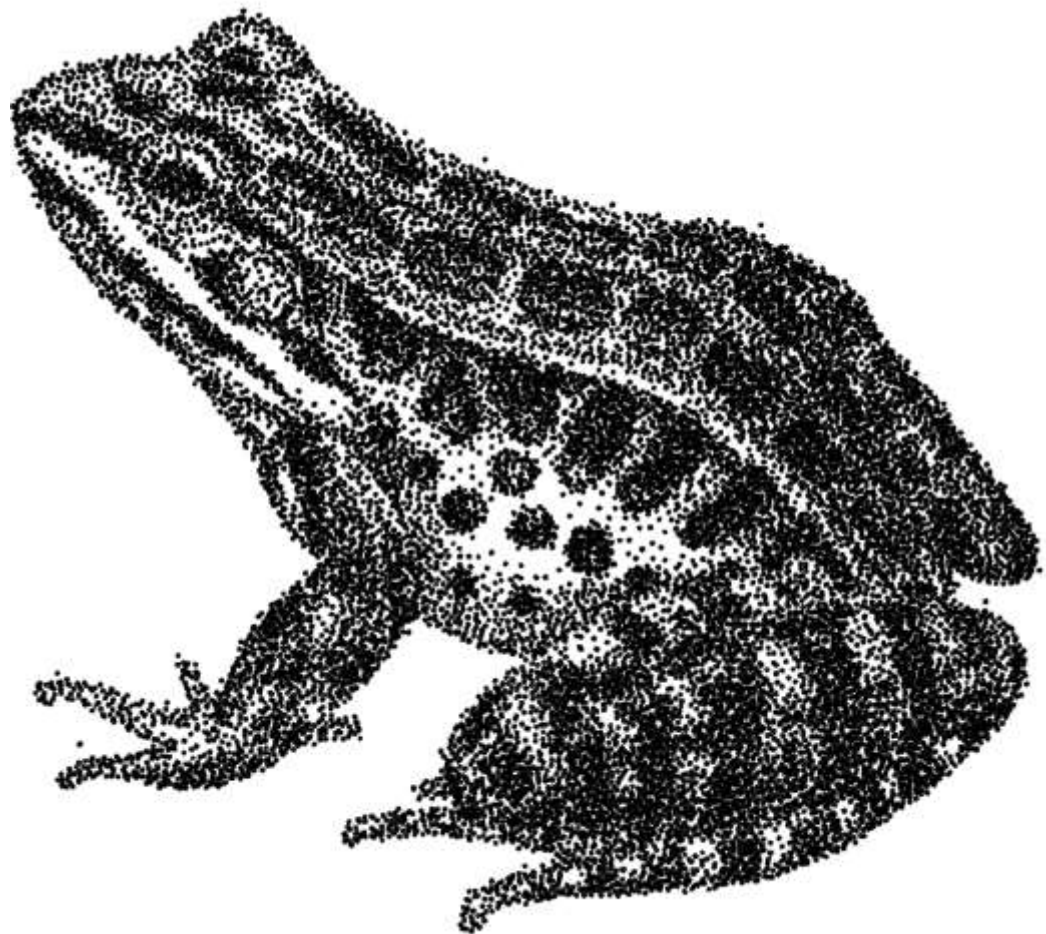


# STIPPLING

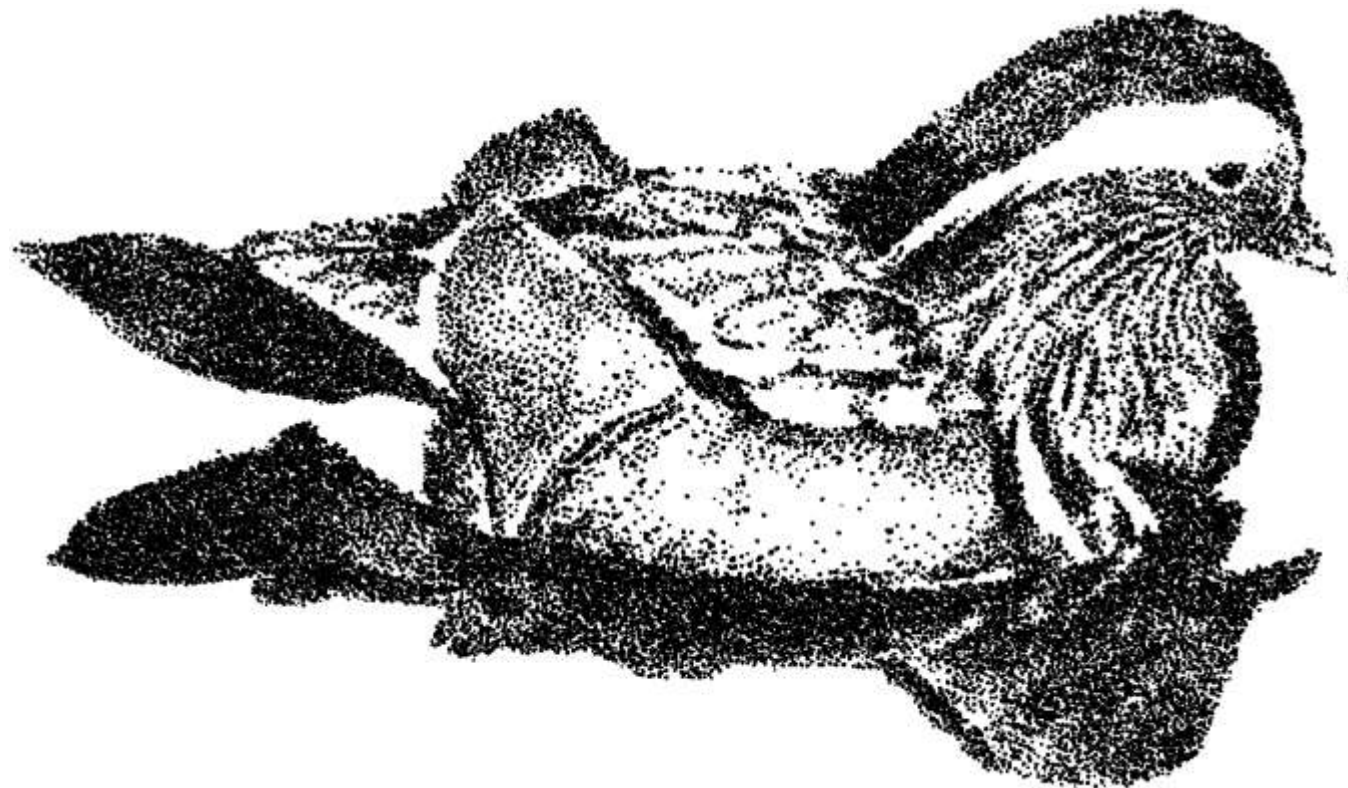


Kopf et al., 2006

# STIPPLING

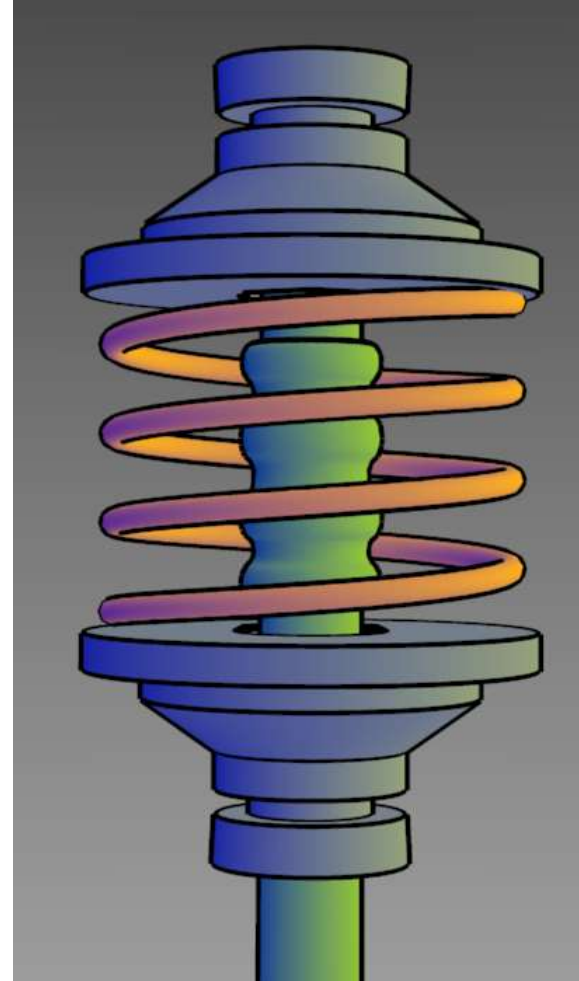
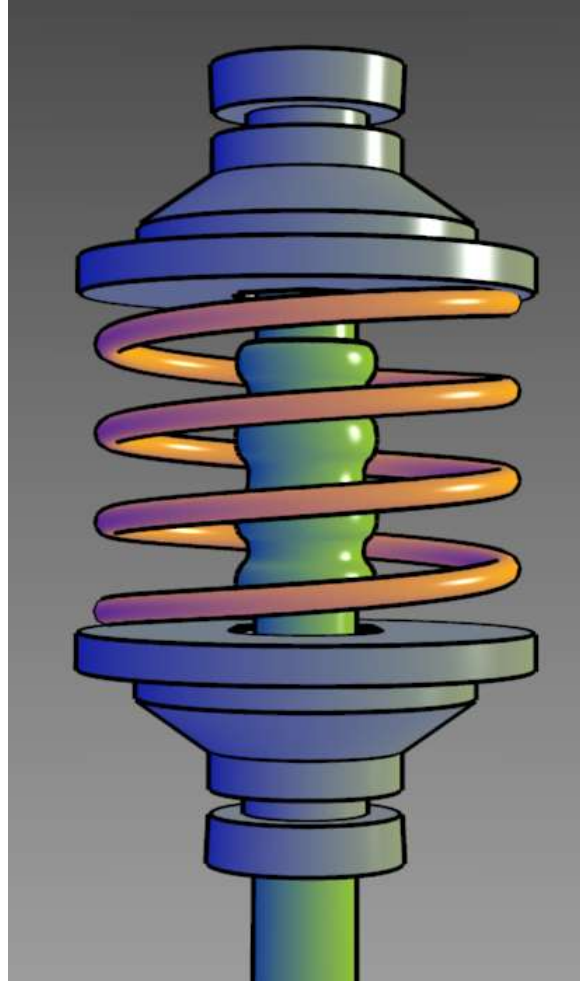


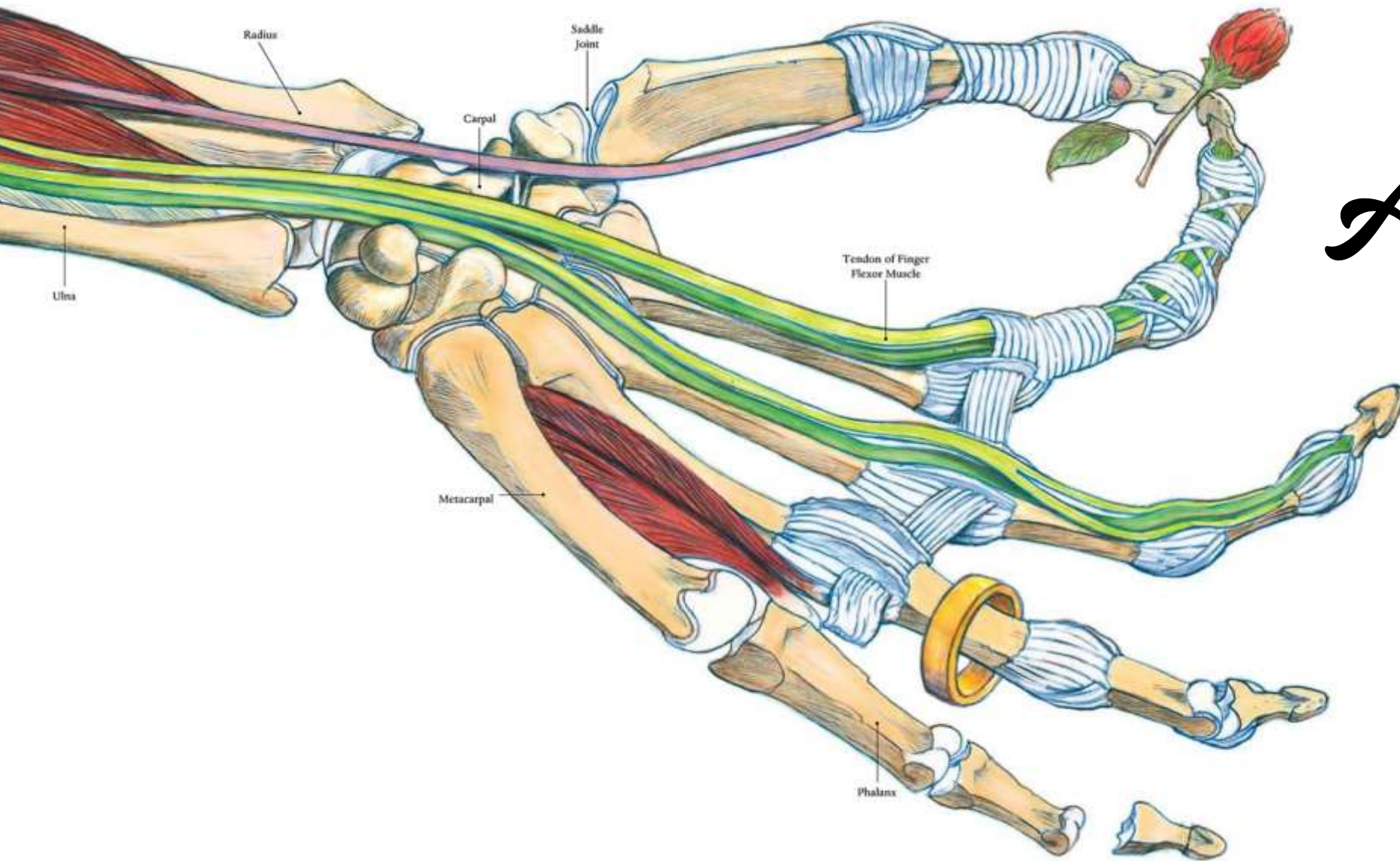
Kim et al., 2009



Martín et al., 2011

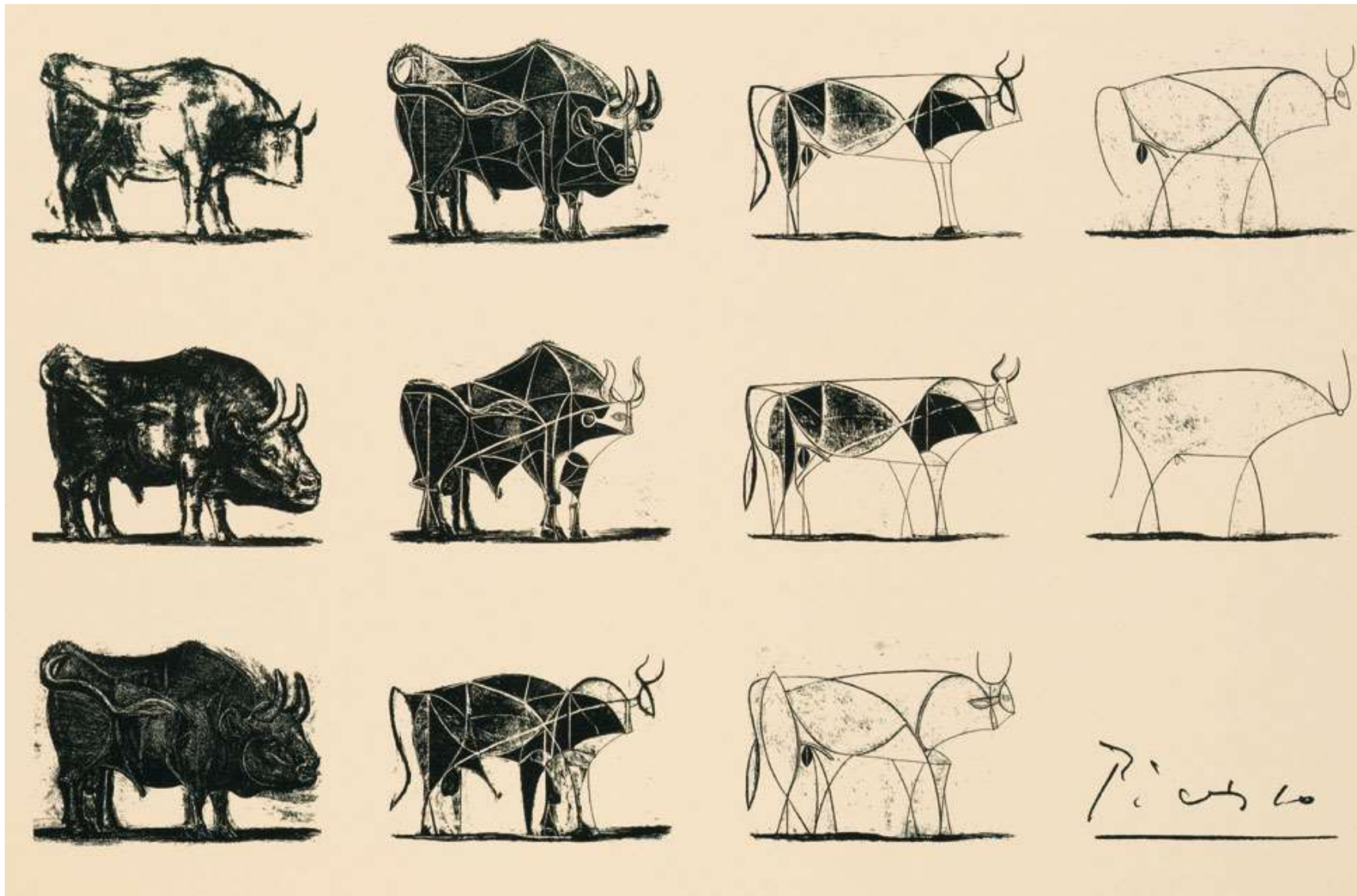
# ILLUMINATION MODELS



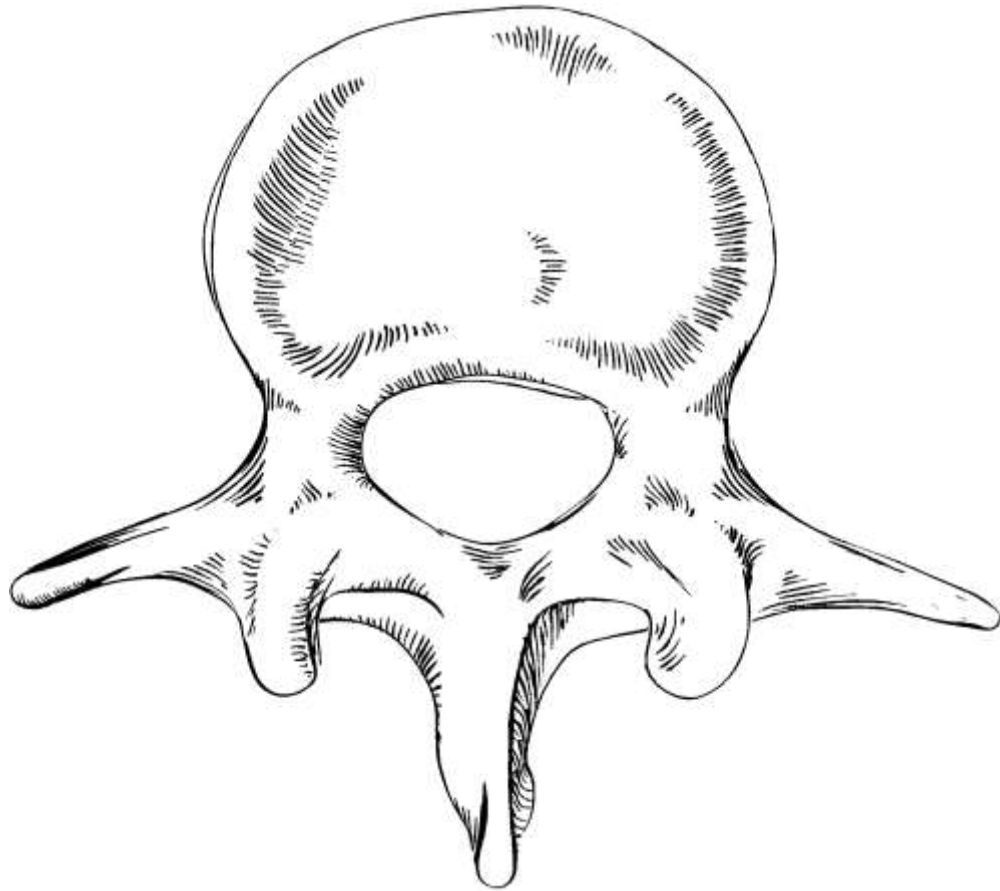


# *Visual Abstraction*

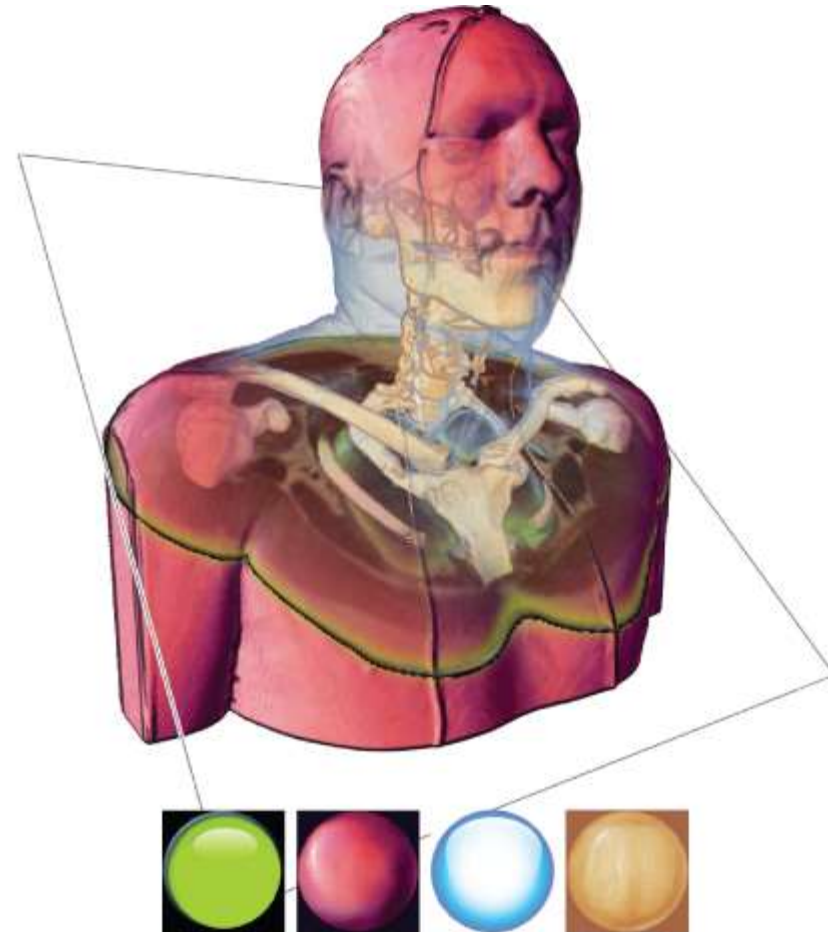
# VISUAL ABSTRACTION



# LOW-LEVEL VS. HIGH-LEVEL ABSTRACTION

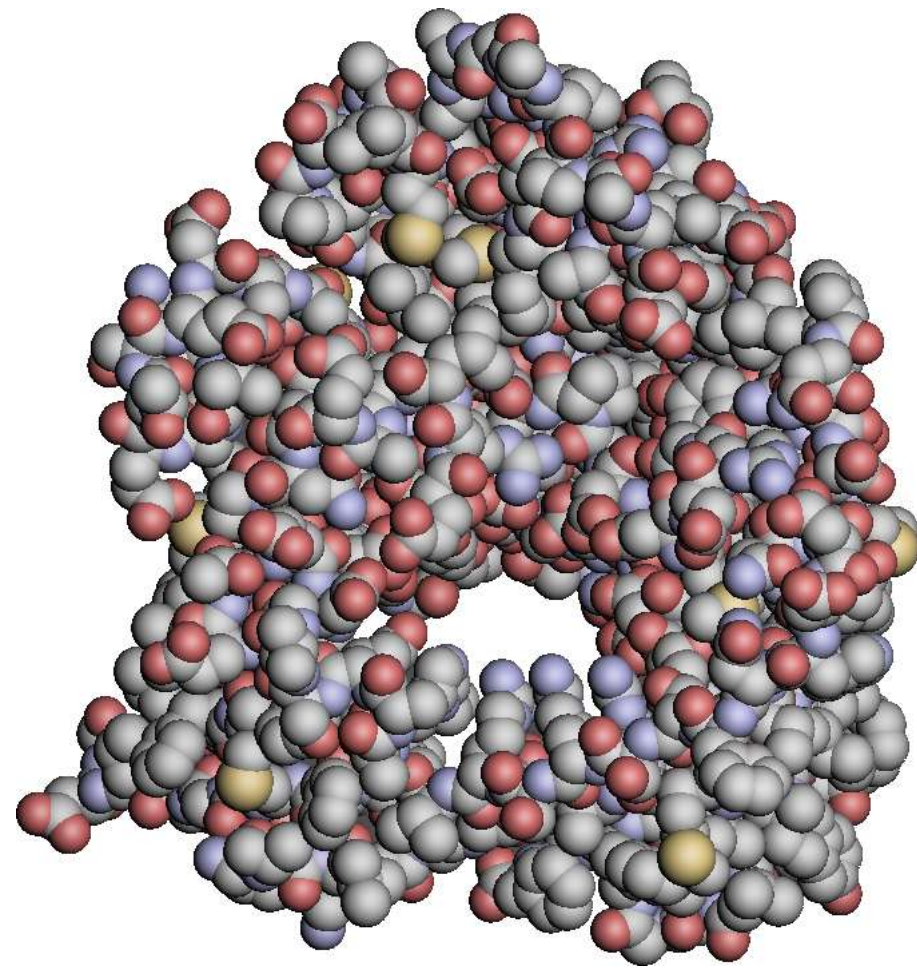
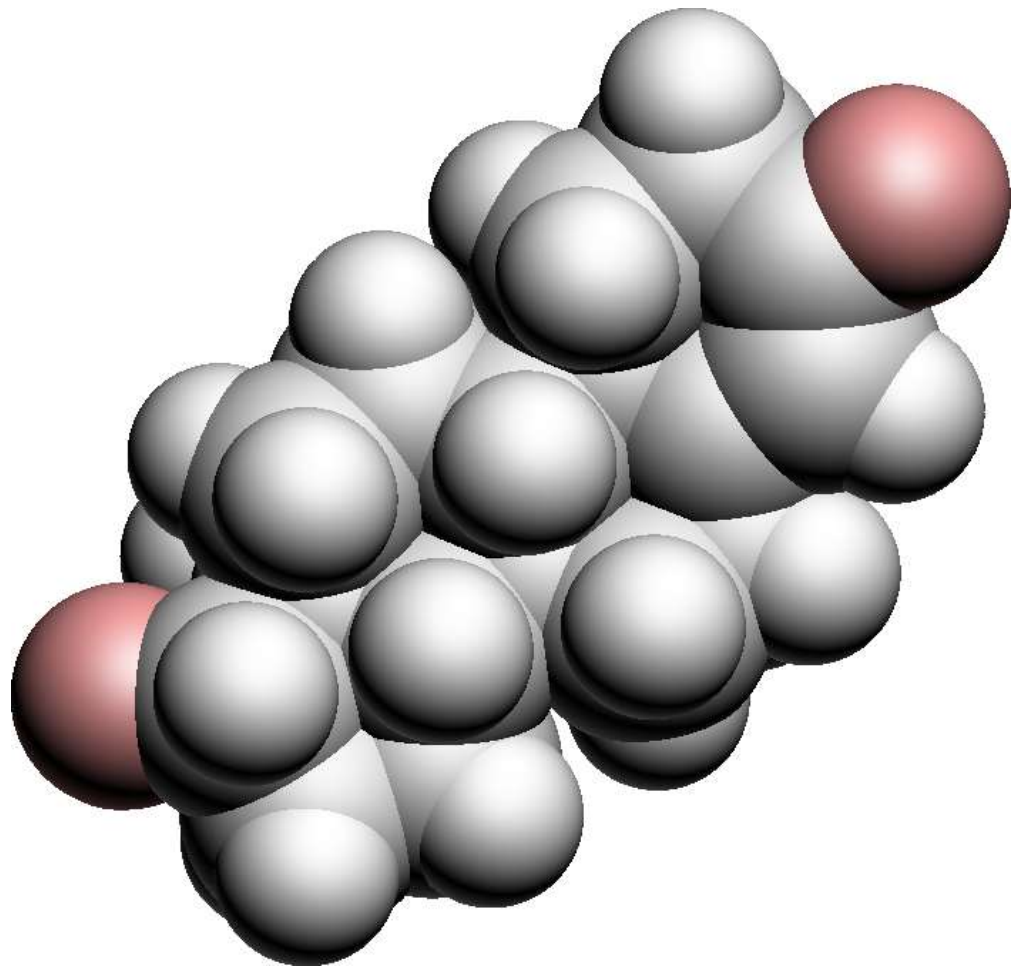


**HOW TO RENDER**

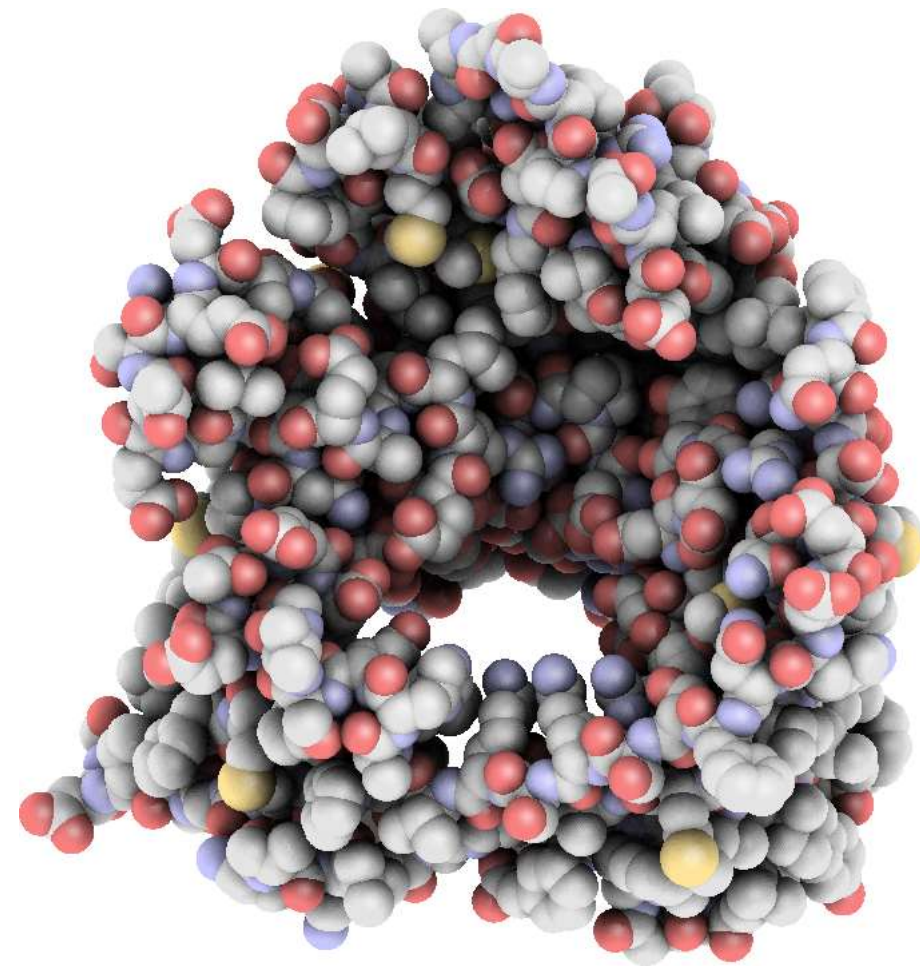
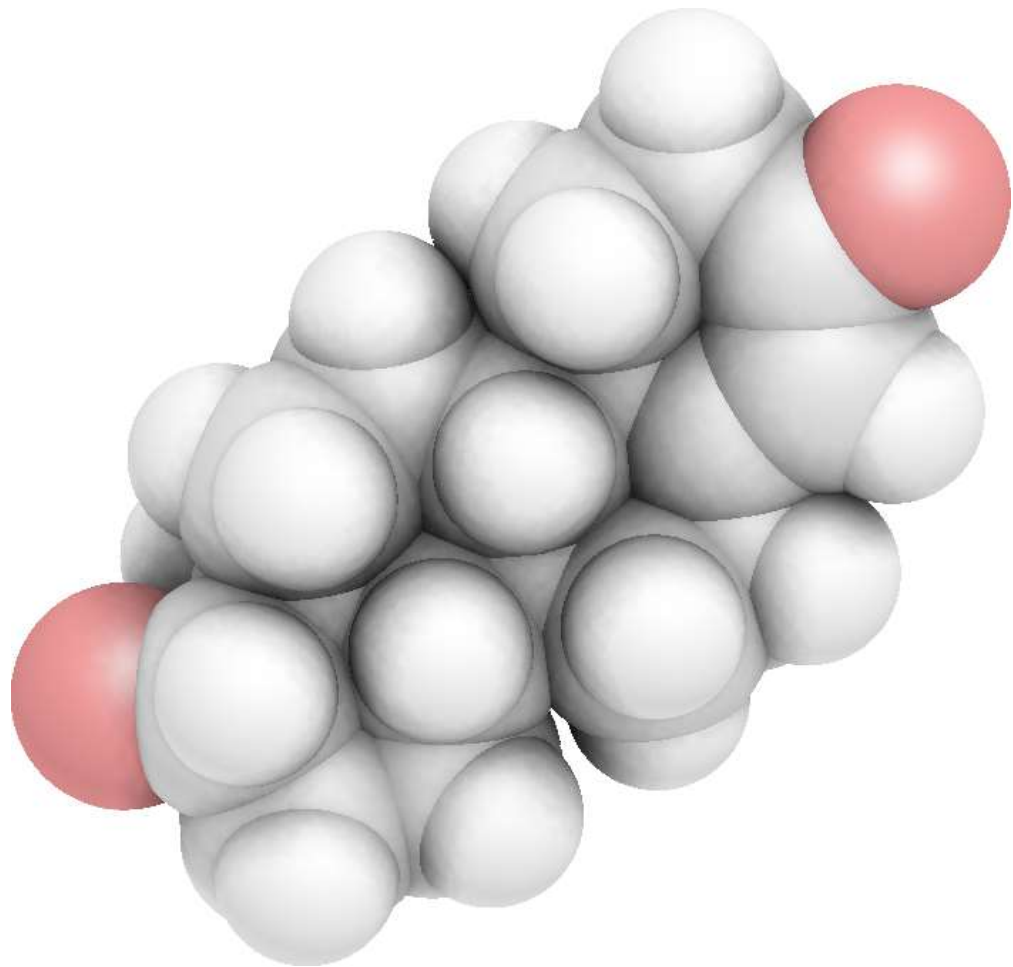


**WHAT TO RENDER**

# EXAMPLE: MOLECULAR VISUALIZATION

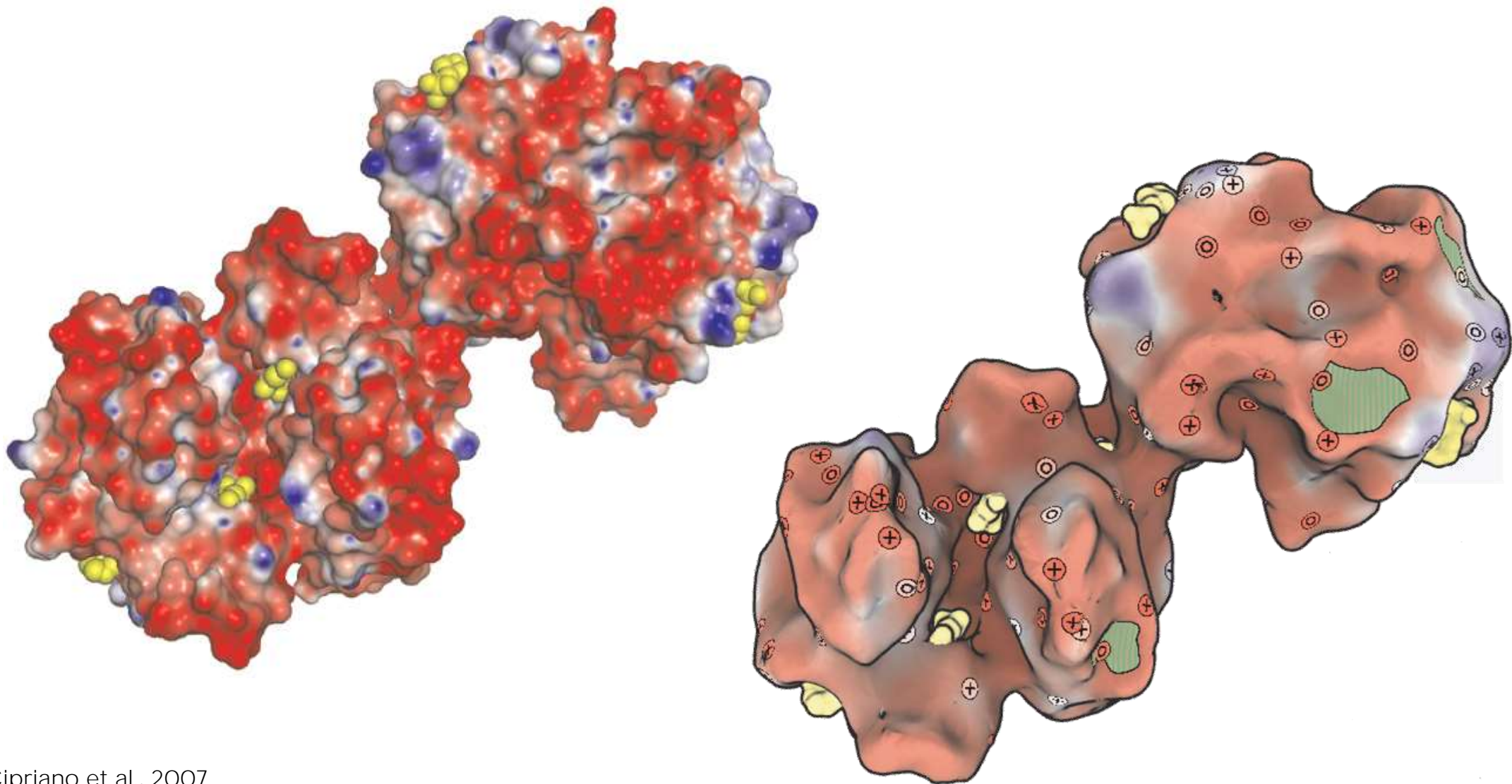


# EXAMPLE: MOLECULAR VISUALIZATION

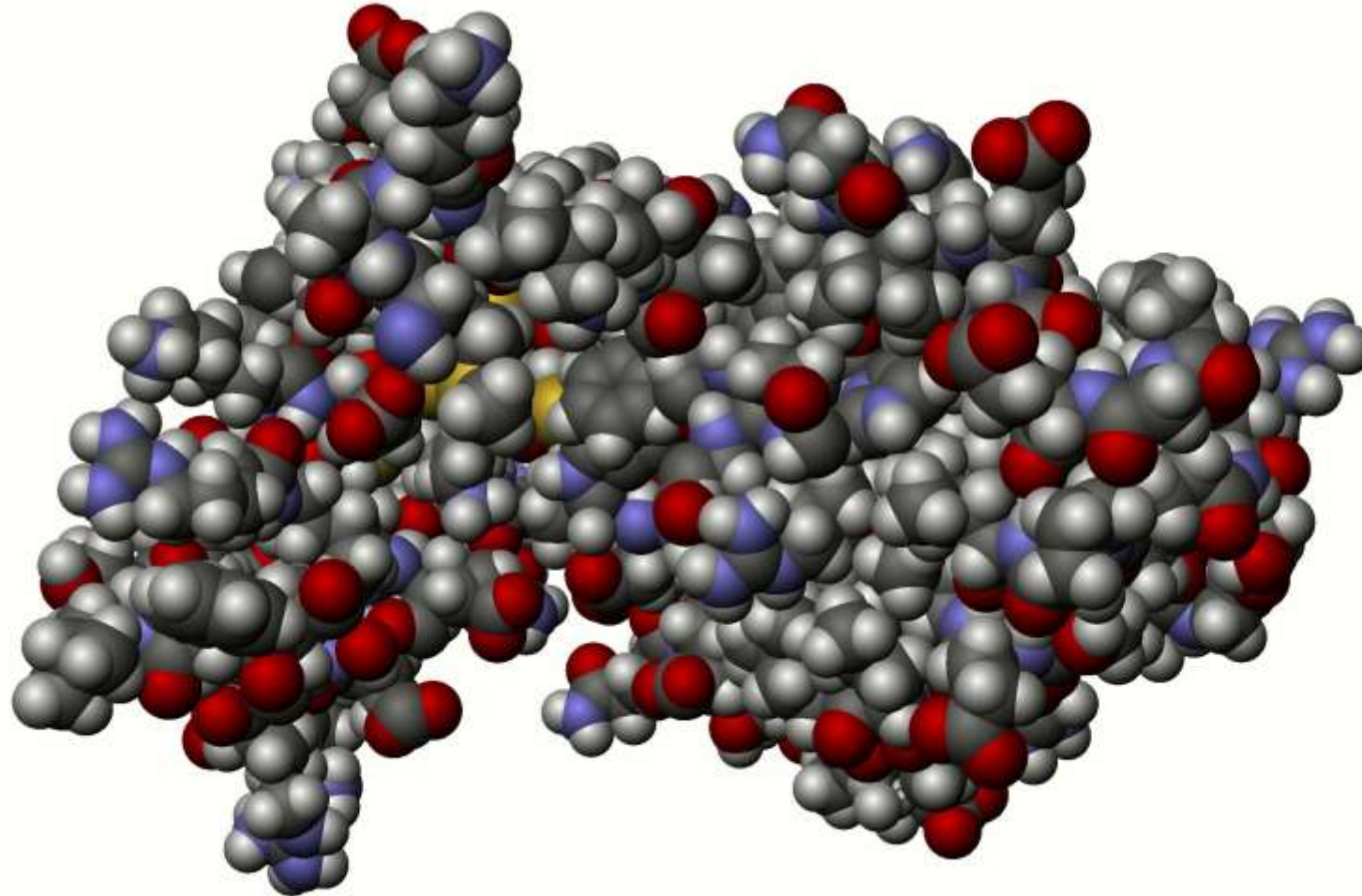




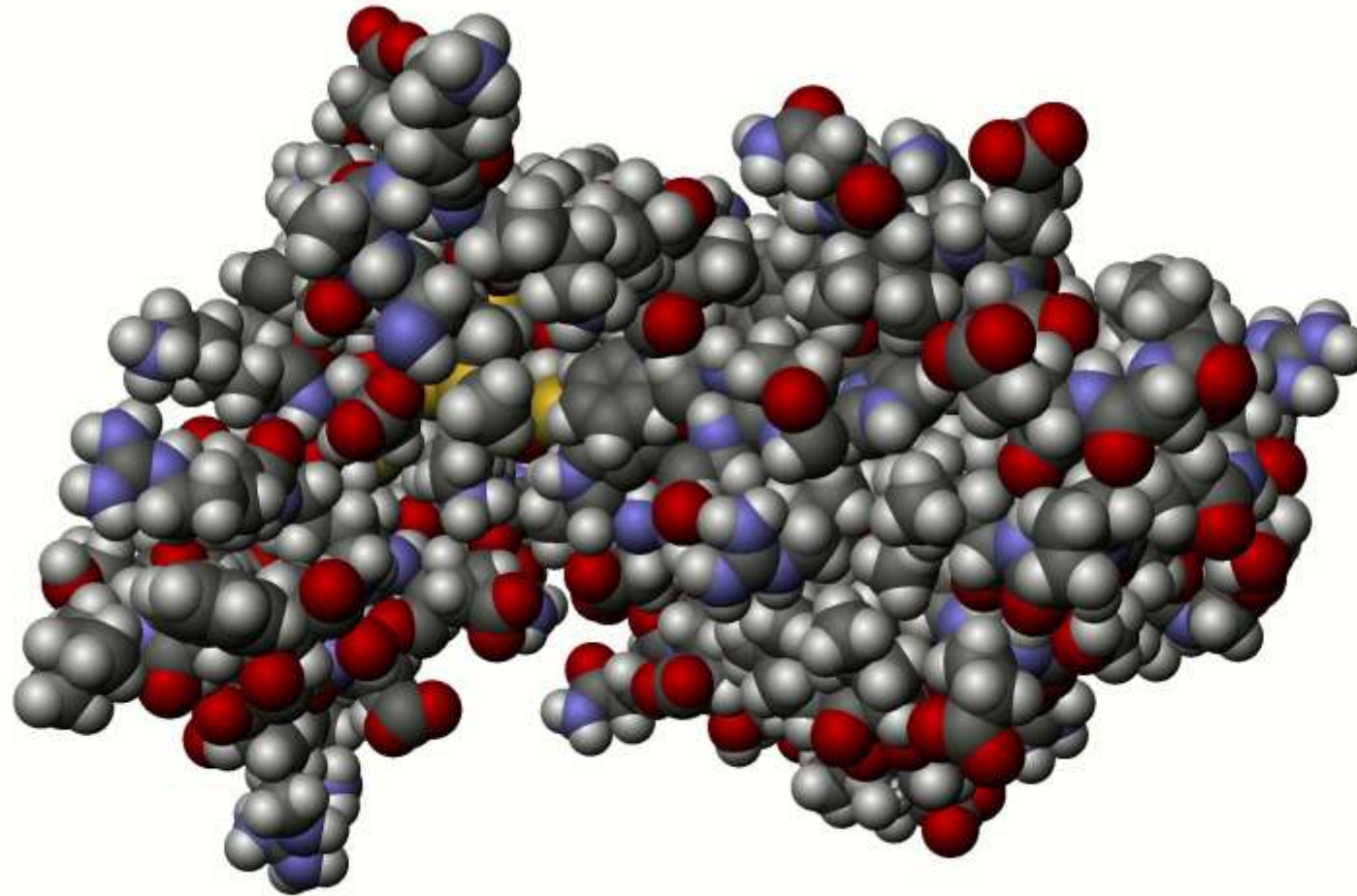
# EXAMPLE: MOLECULAR VISUALIZATION



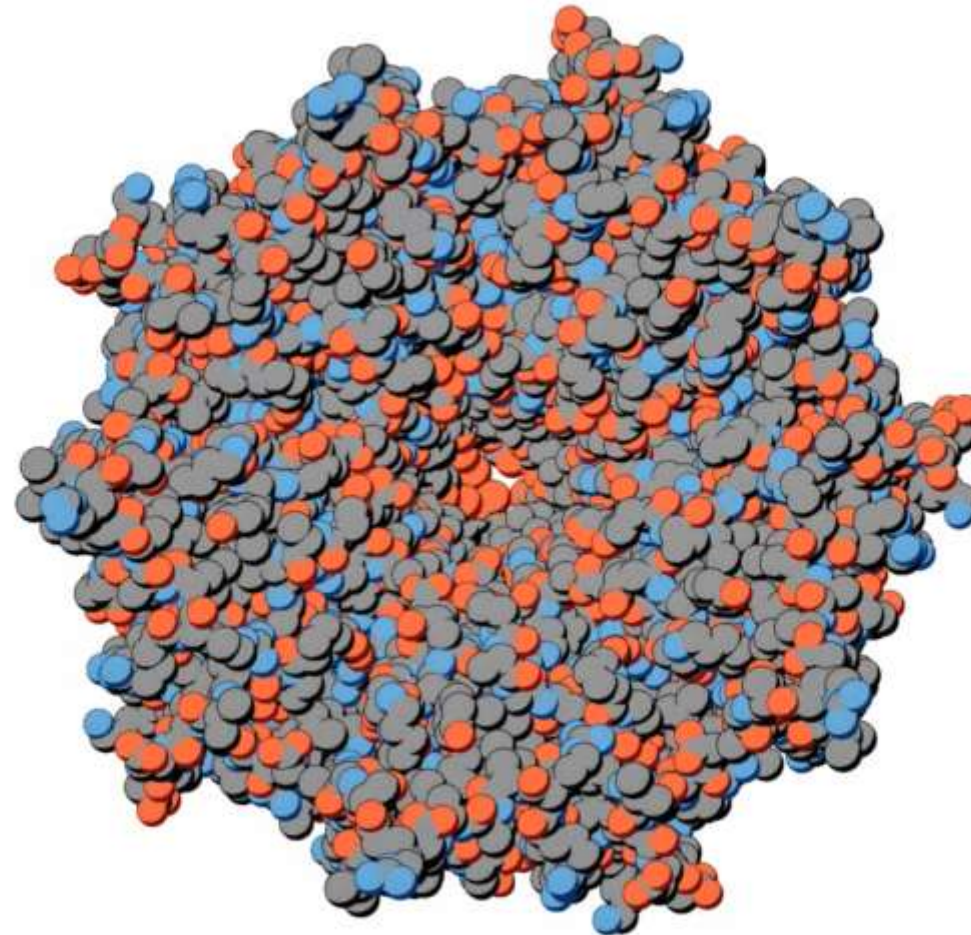
# EXAMPLE: MOLECULAR VISUALIZATION



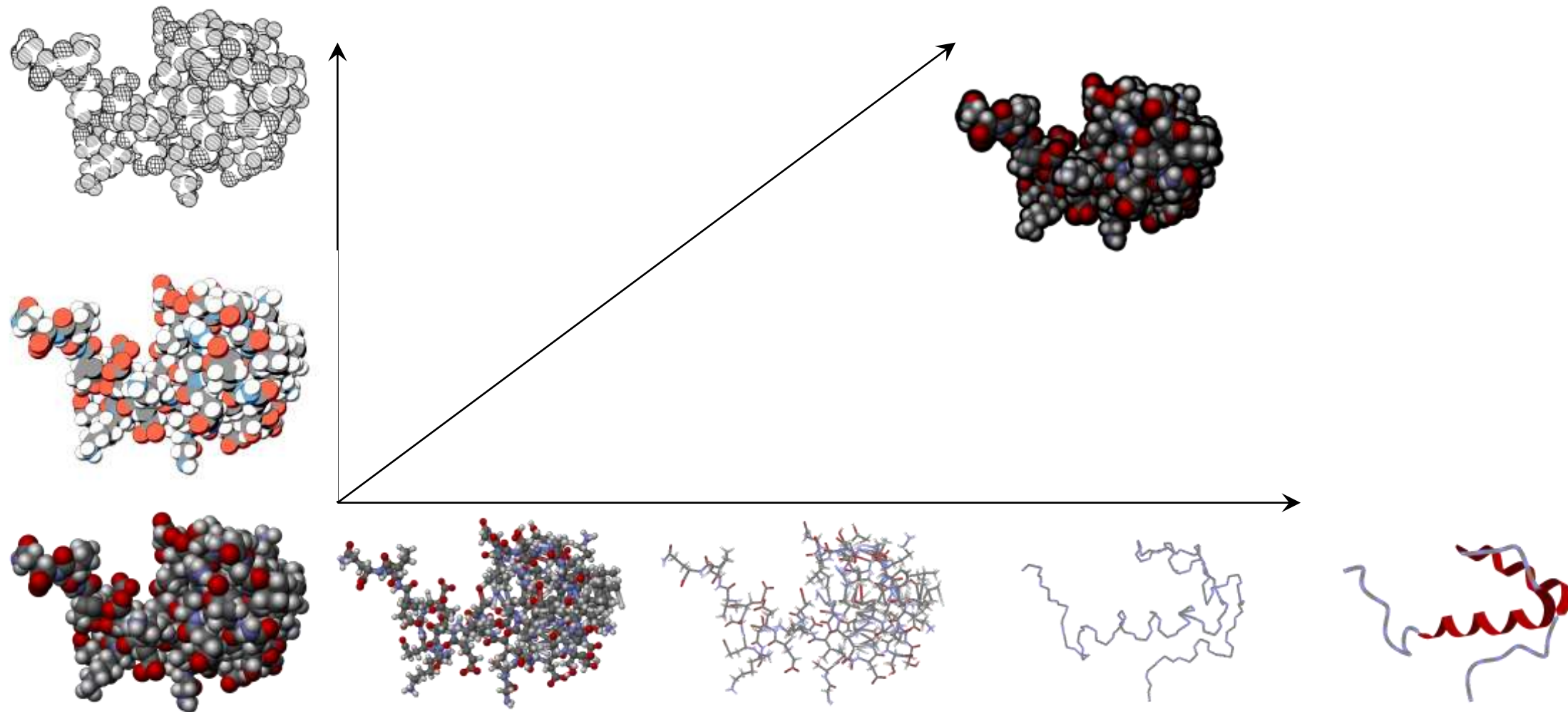
# EXAMPLE: MOLECULAR VISUALIZATION



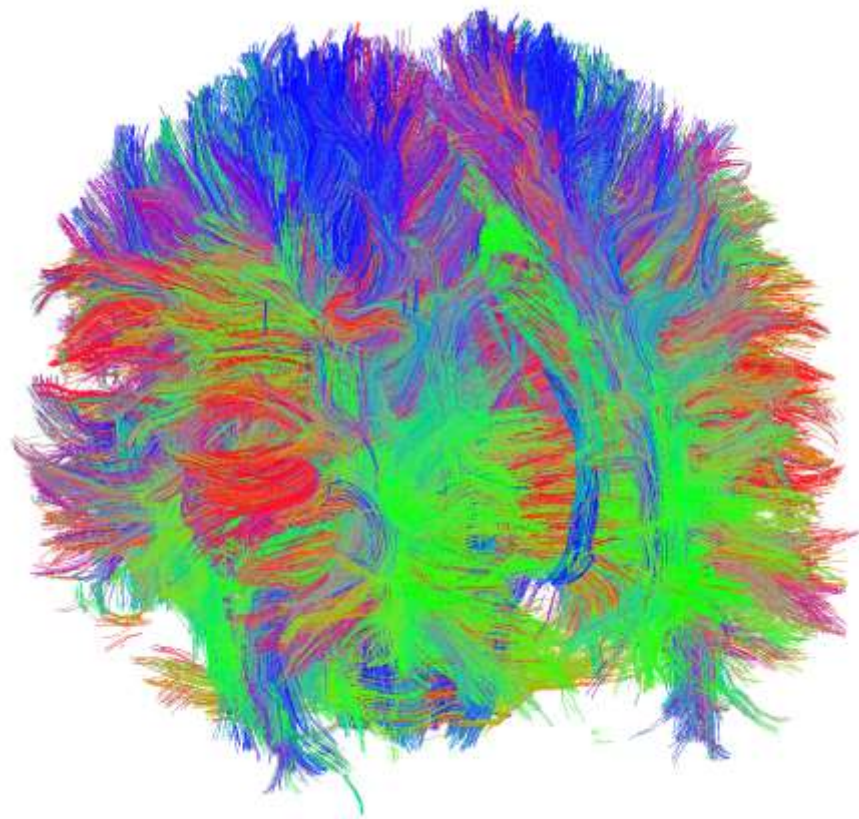
# EXAMPLE: MOLECULAR VISUALIZATION



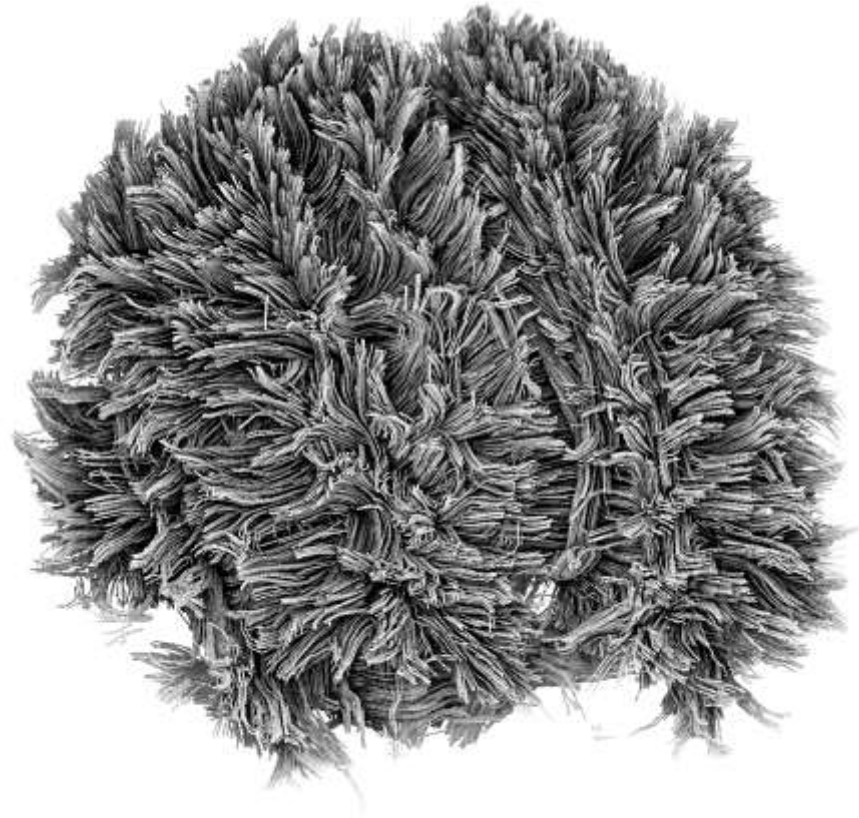
# ABSTRACTION SPACES



# PHOTOMETRIC VS. GEOMETRIC ABSTRACTION

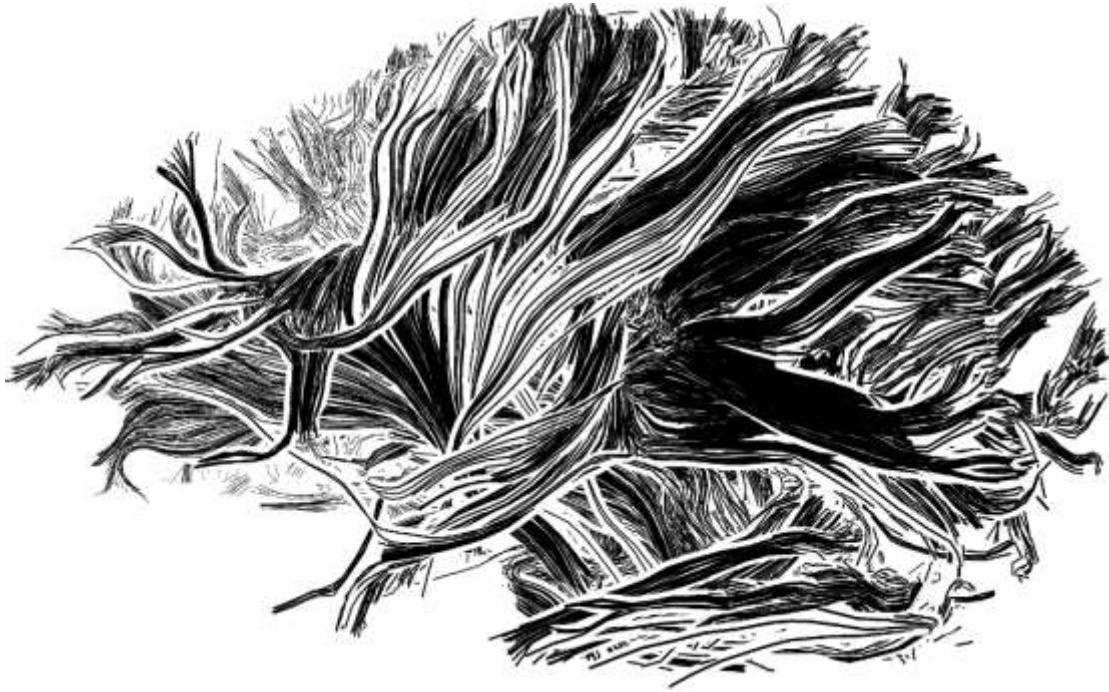


# PHOTOMETRIC VS. GEOMETRIC ABSTRACTION

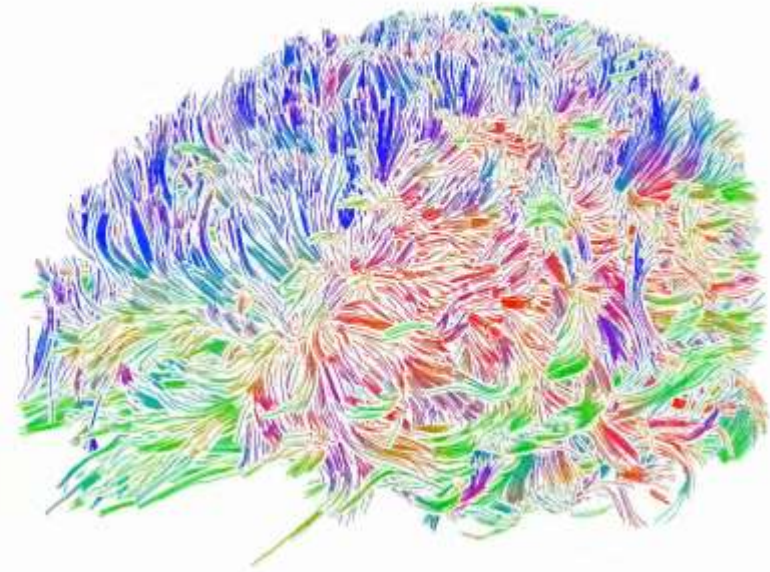


Eichelbaum et al., 2013

# PHOTOMETRIC VS. GEOMETRIC ABSTRACTION



Everts et al., 2009



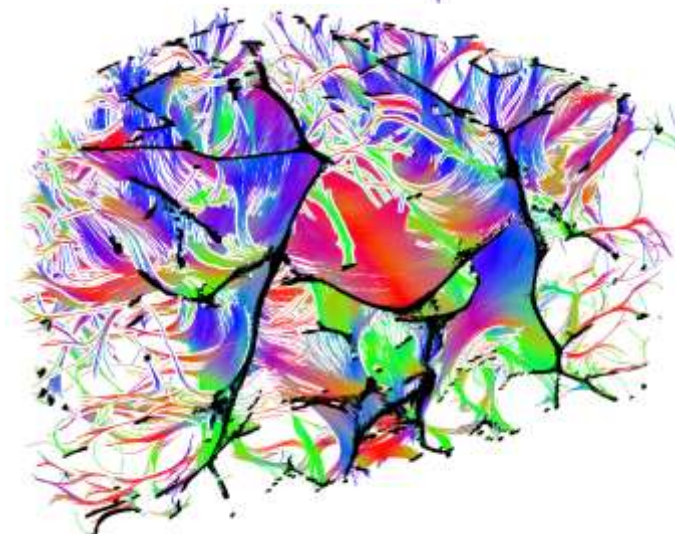
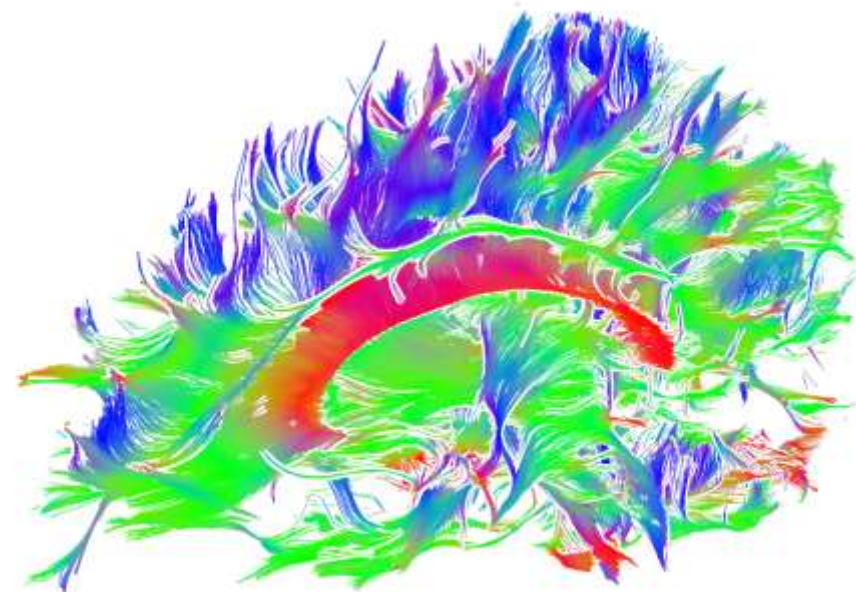
Everts et al., 2015



# PHOTOMETRIC VS. GEOMETRIC ABSTRACTION

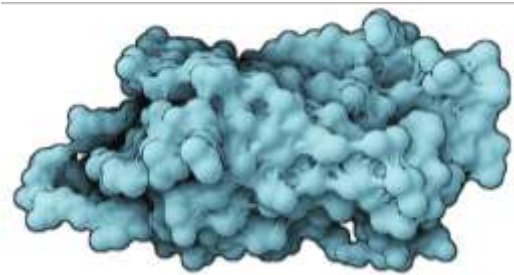


Everts et al., 2009

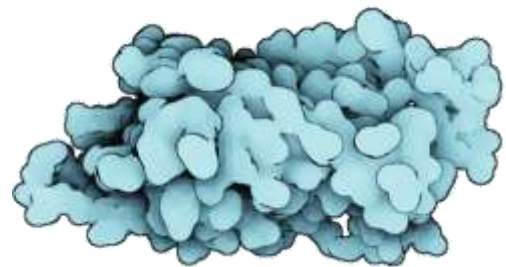


Everts et al., 2015

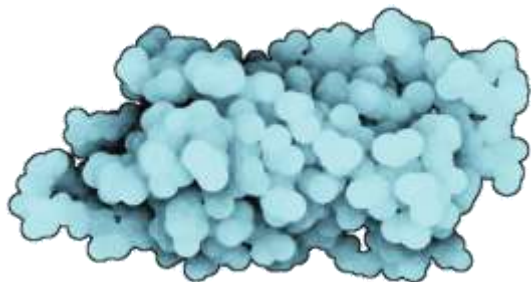
# CONTROL OF THE ABSTRACTION



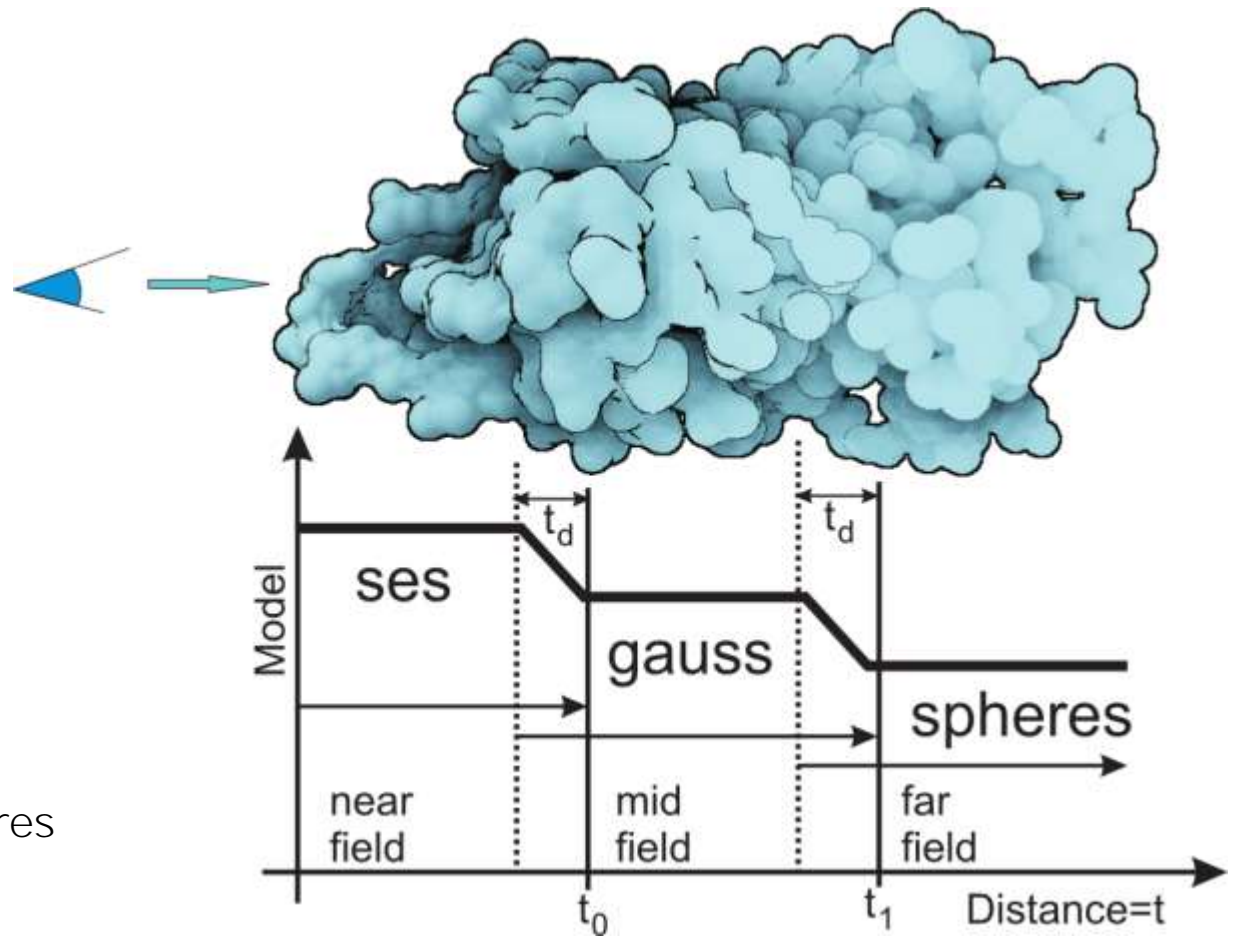
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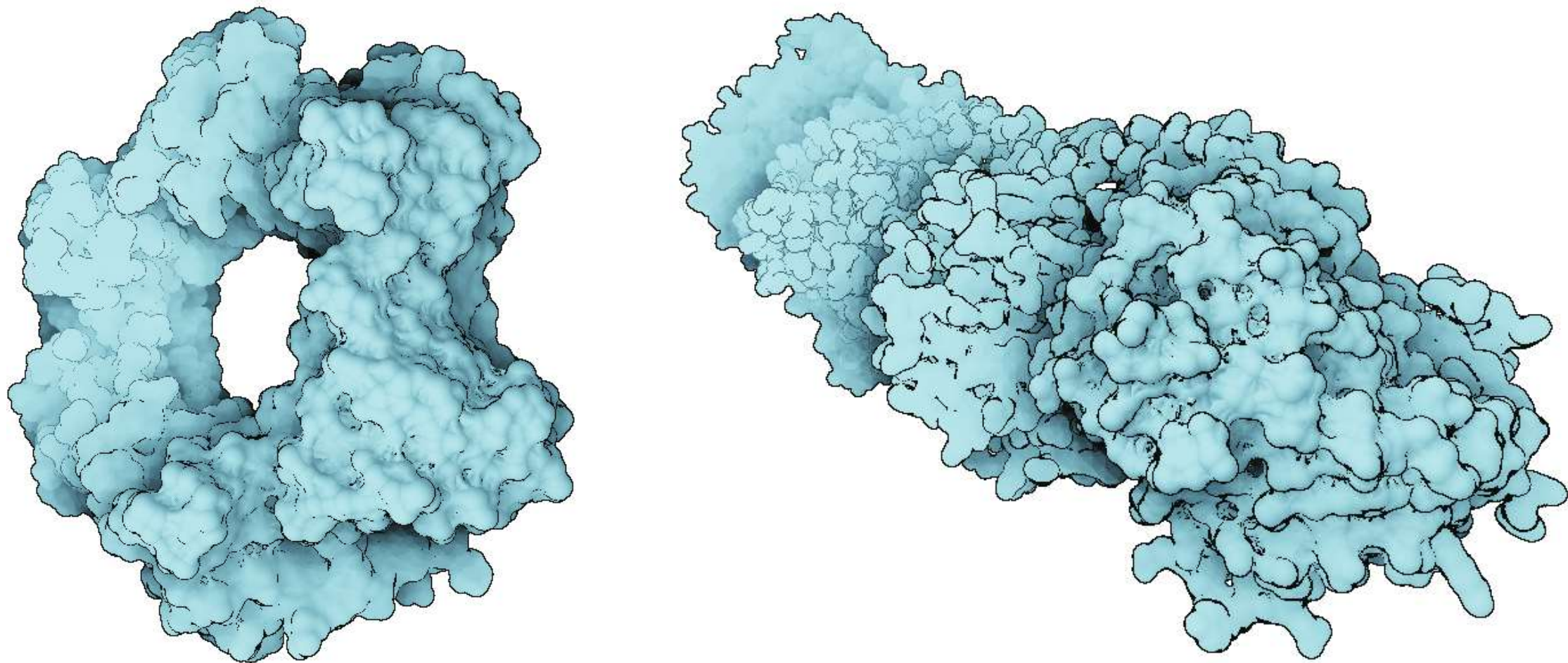
Gaussian kernels



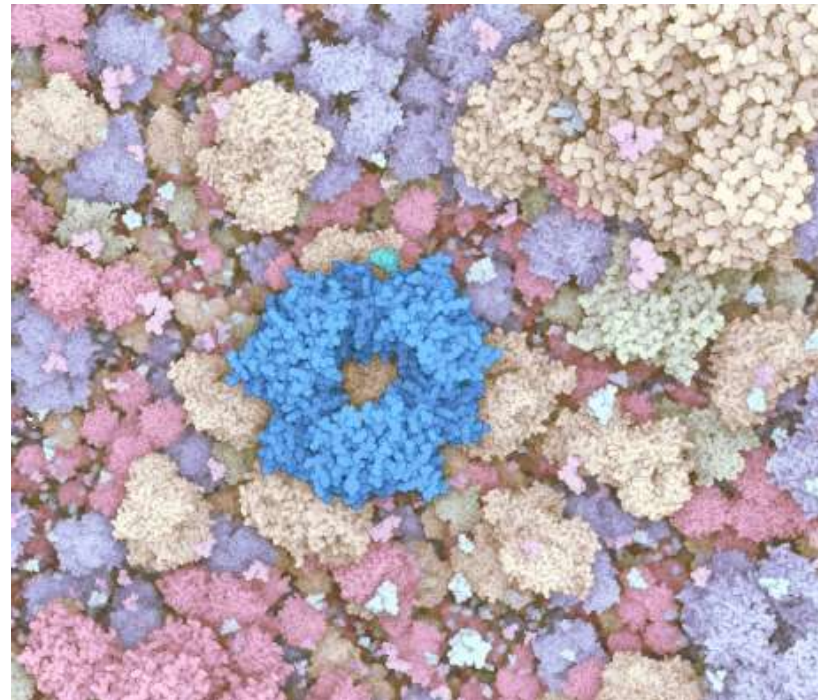
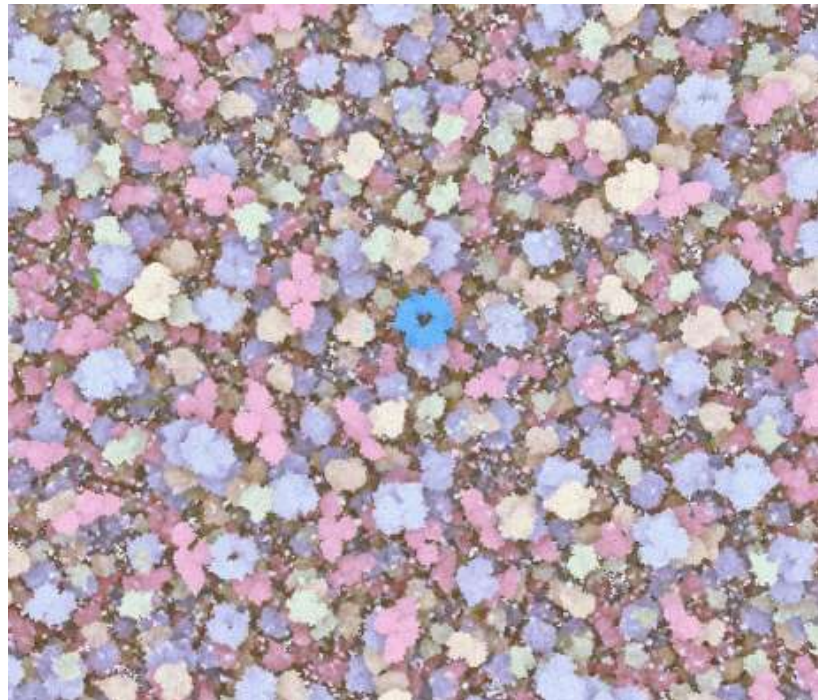
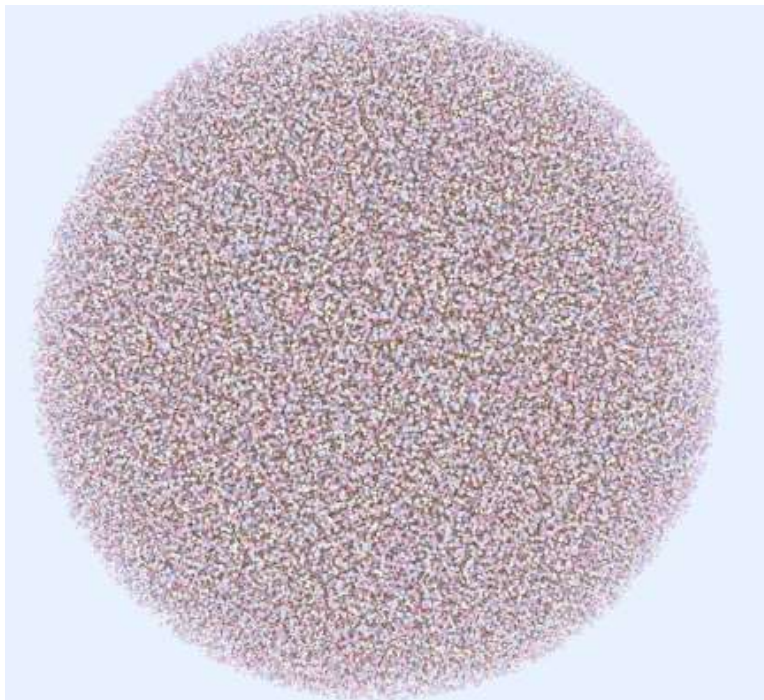
van der Waals spheres



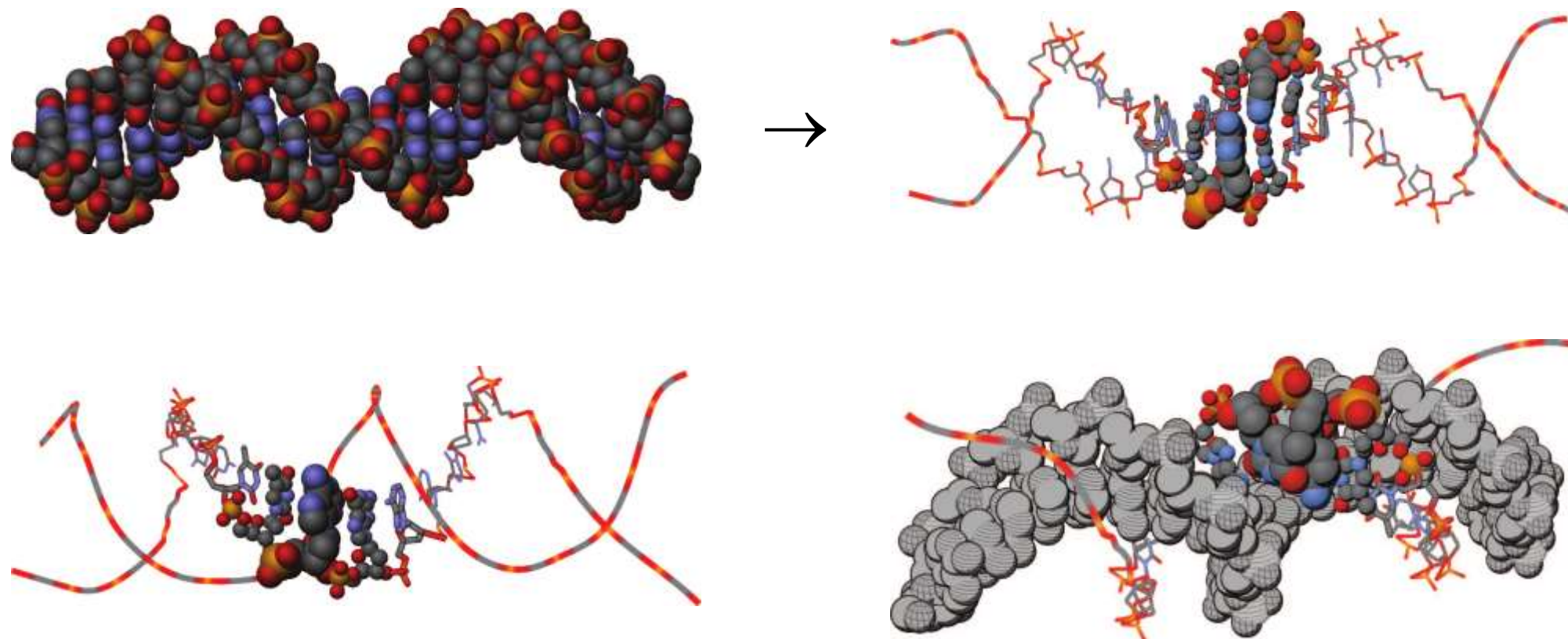
# CONTROL OF THE ABSTRACTION



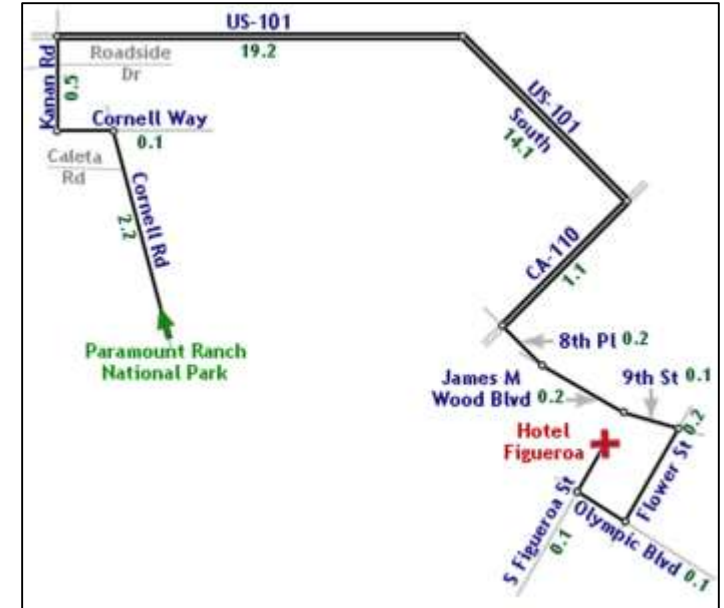
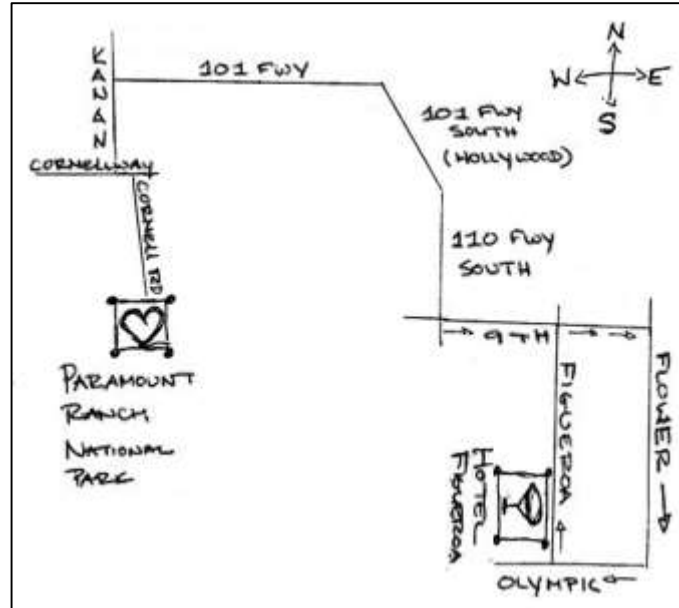
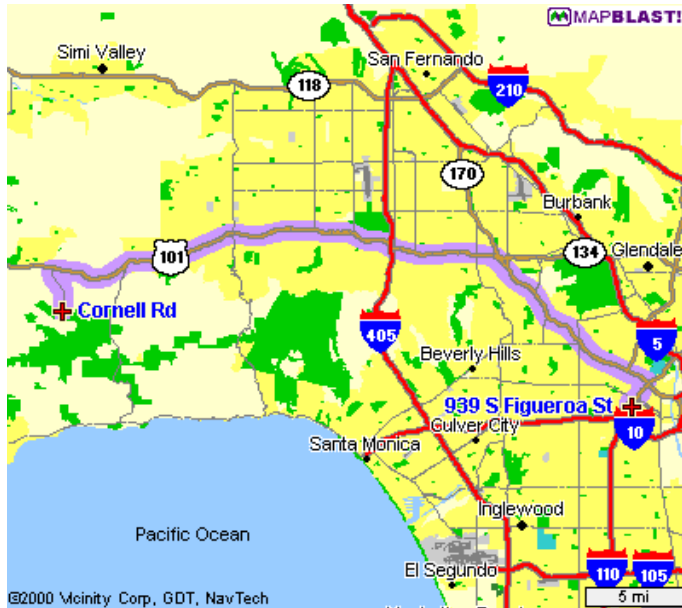
# CONTROL OF THE ABSTRACTION



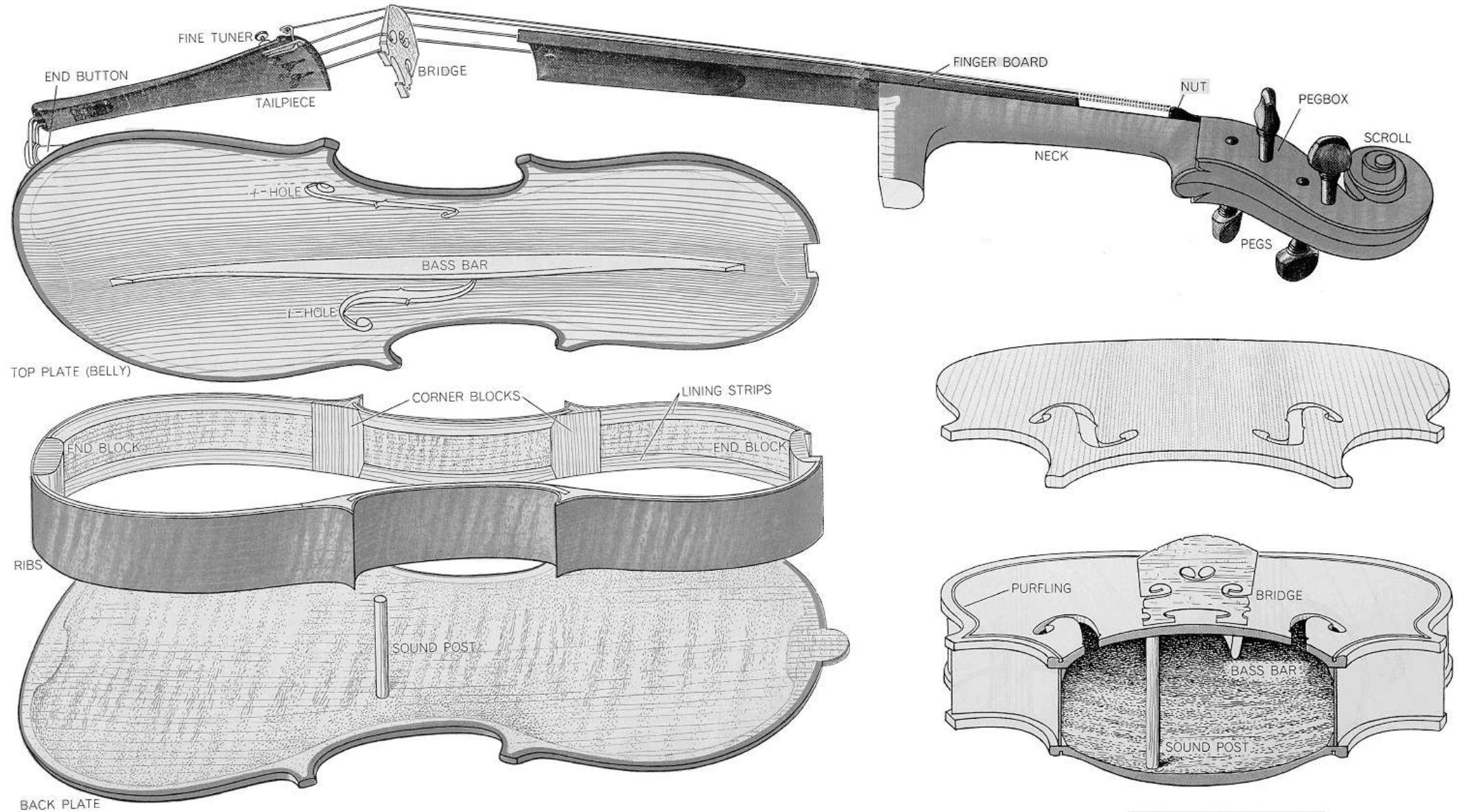
# CONTROL OF THE ABSTRACTION



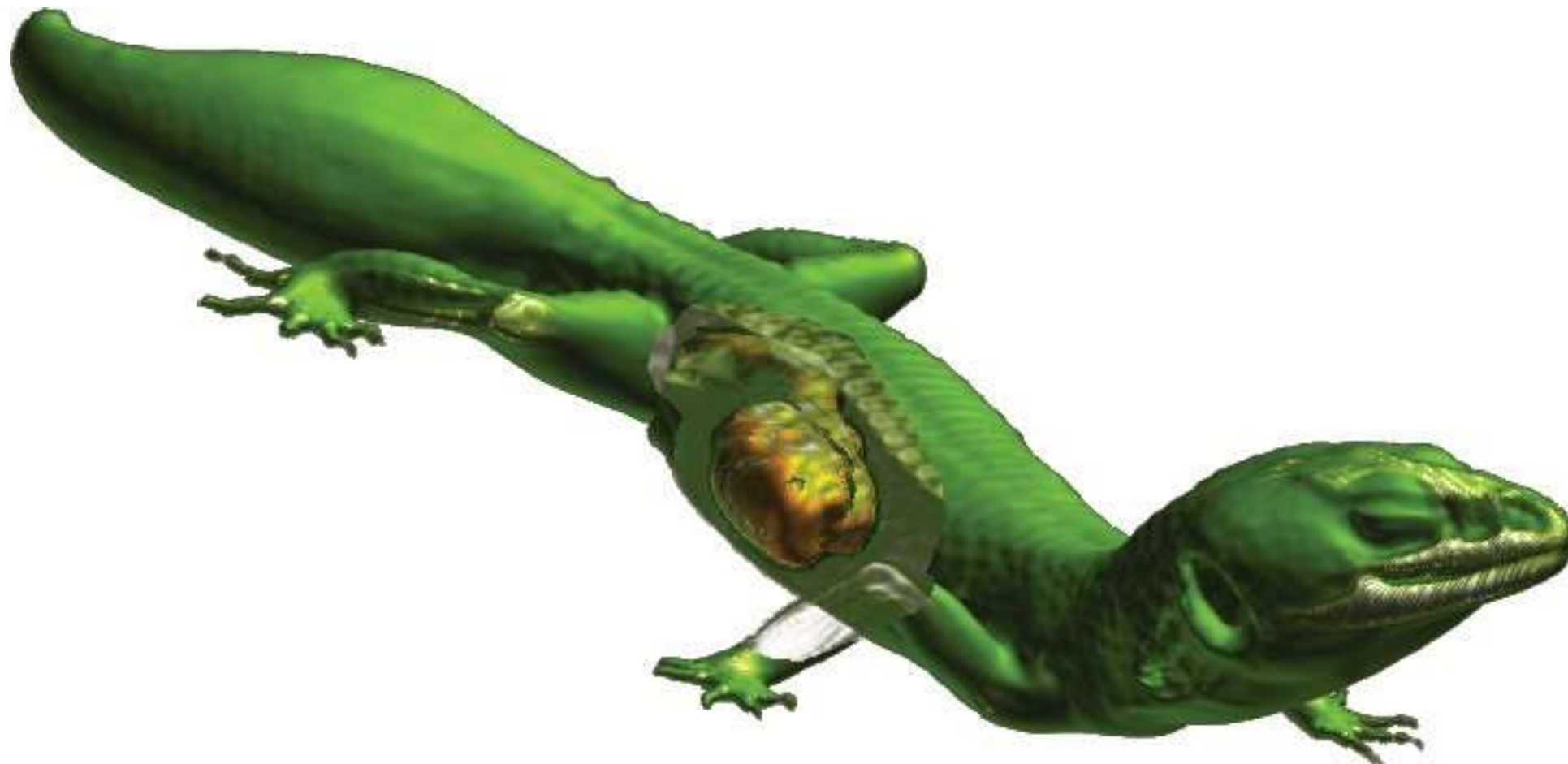
# CONTROL OF THE ABSTRACTION



# Expressive Techniques

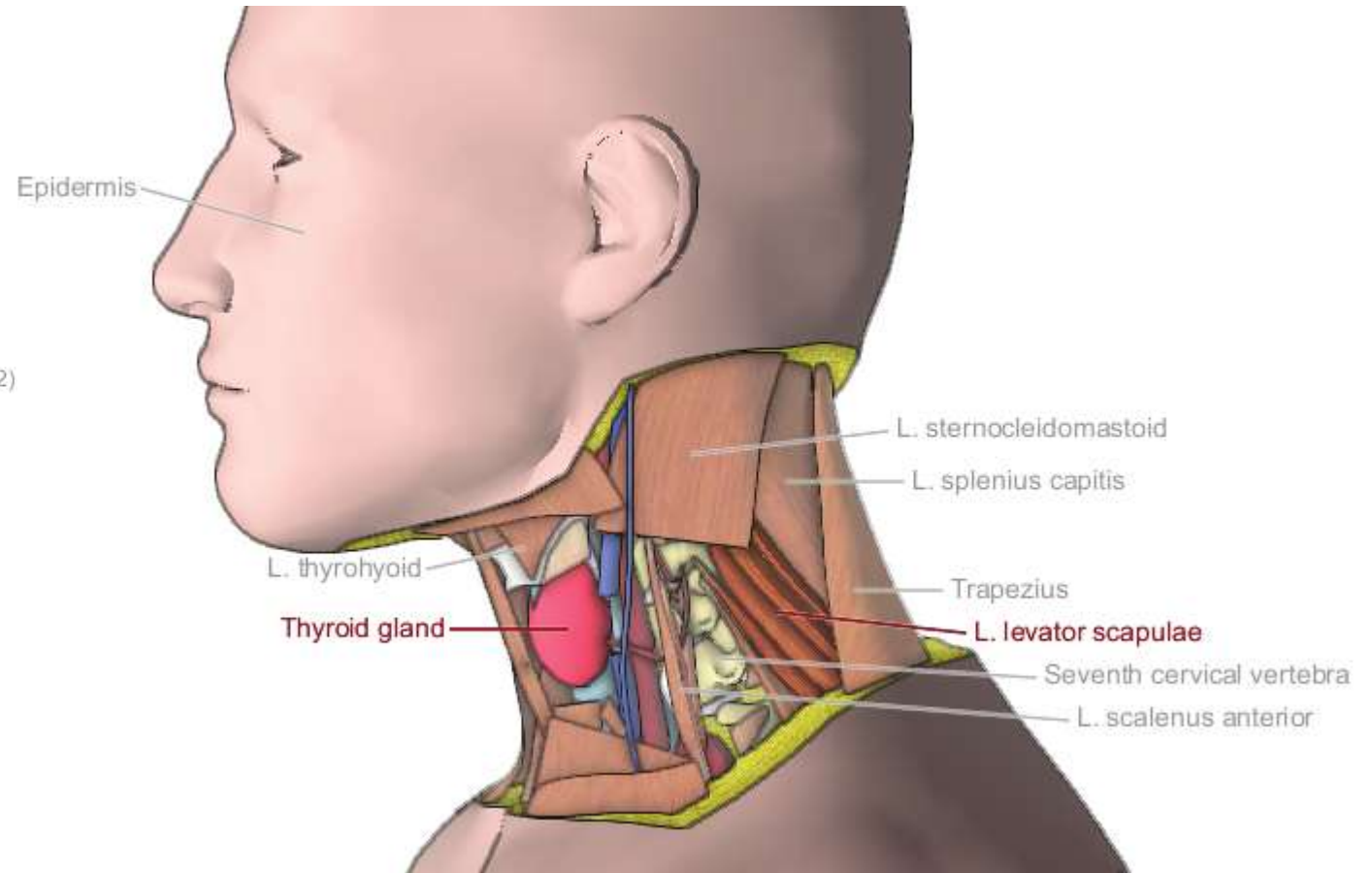
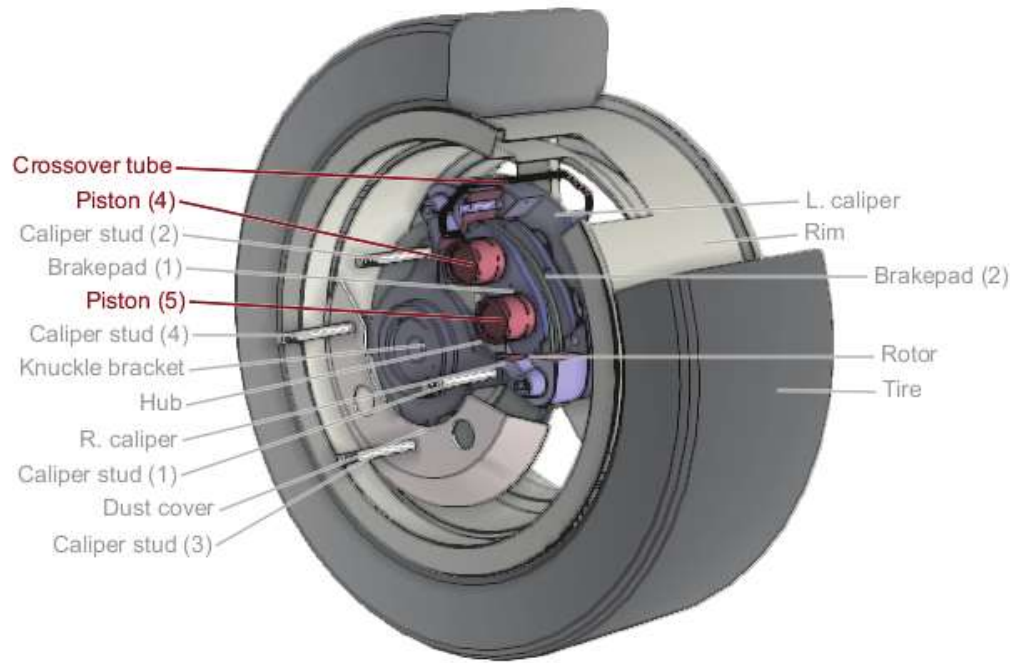


# SMART VISIBILITY

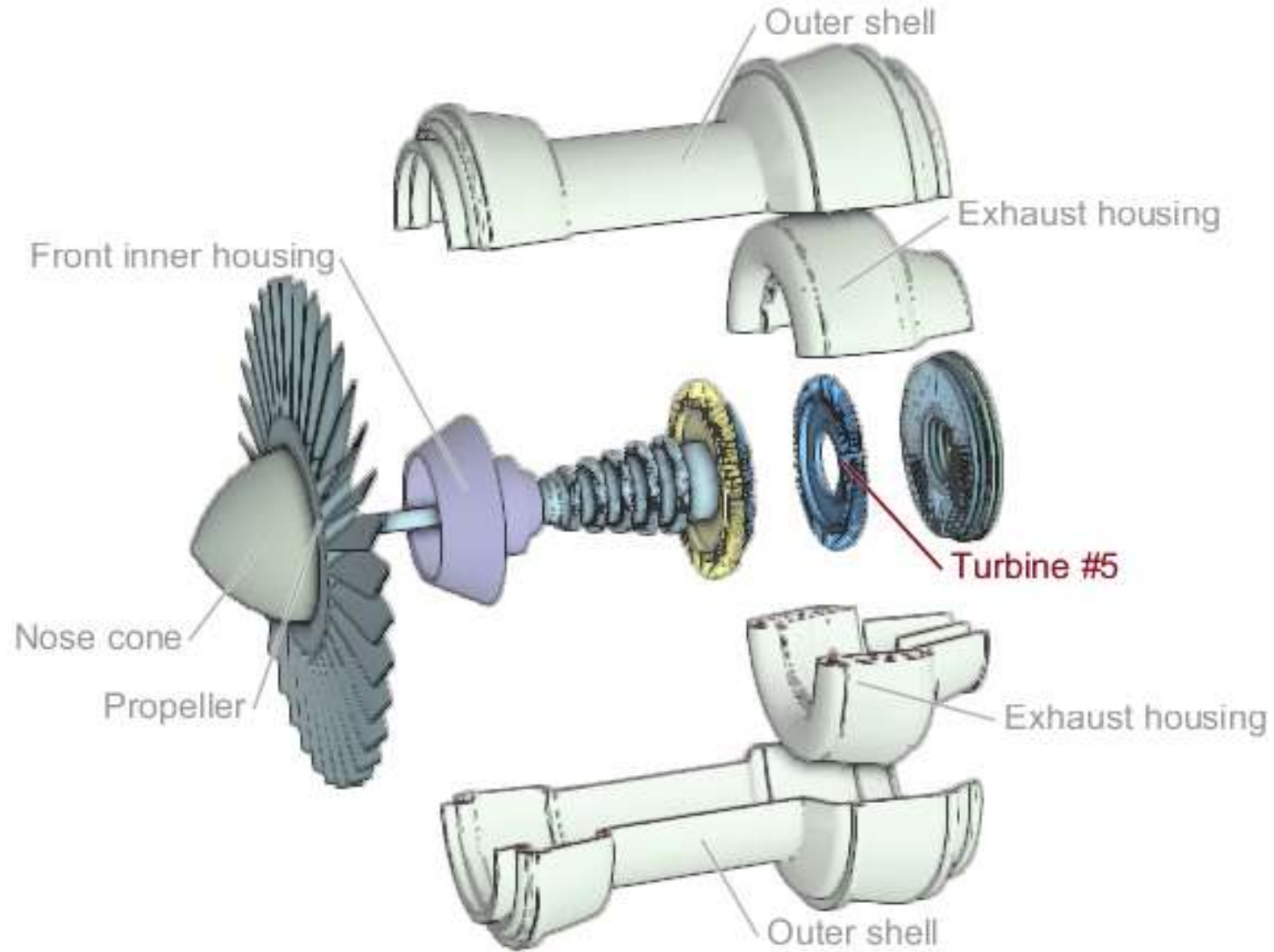




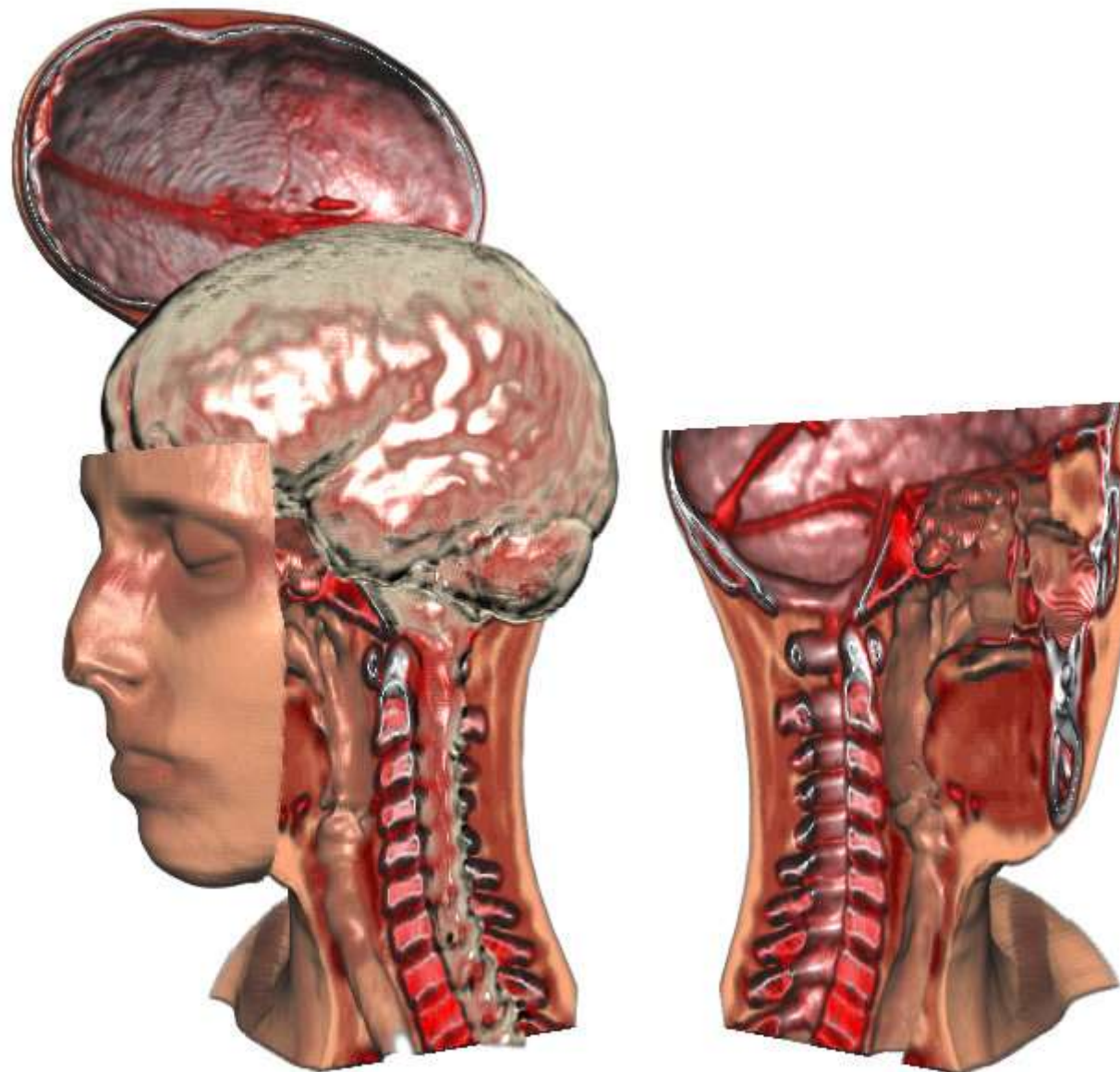
# CUT-AWAY ILLUSTRATION



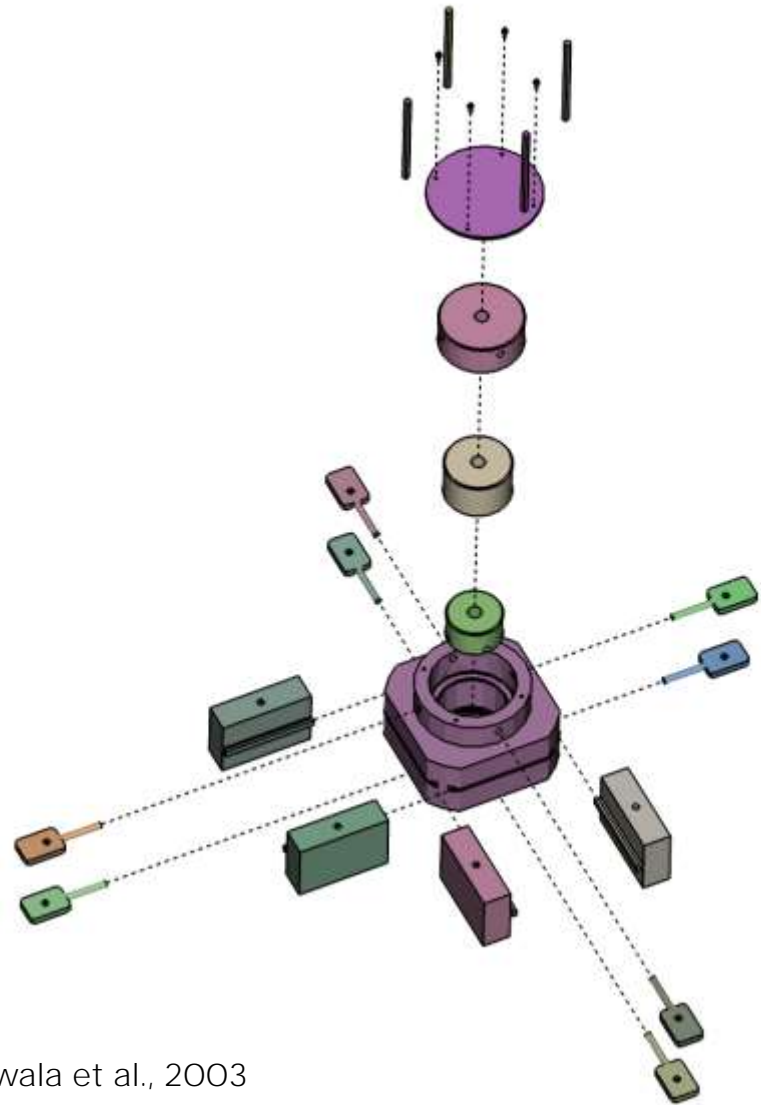
# EXPLOSION DIAGRAMS



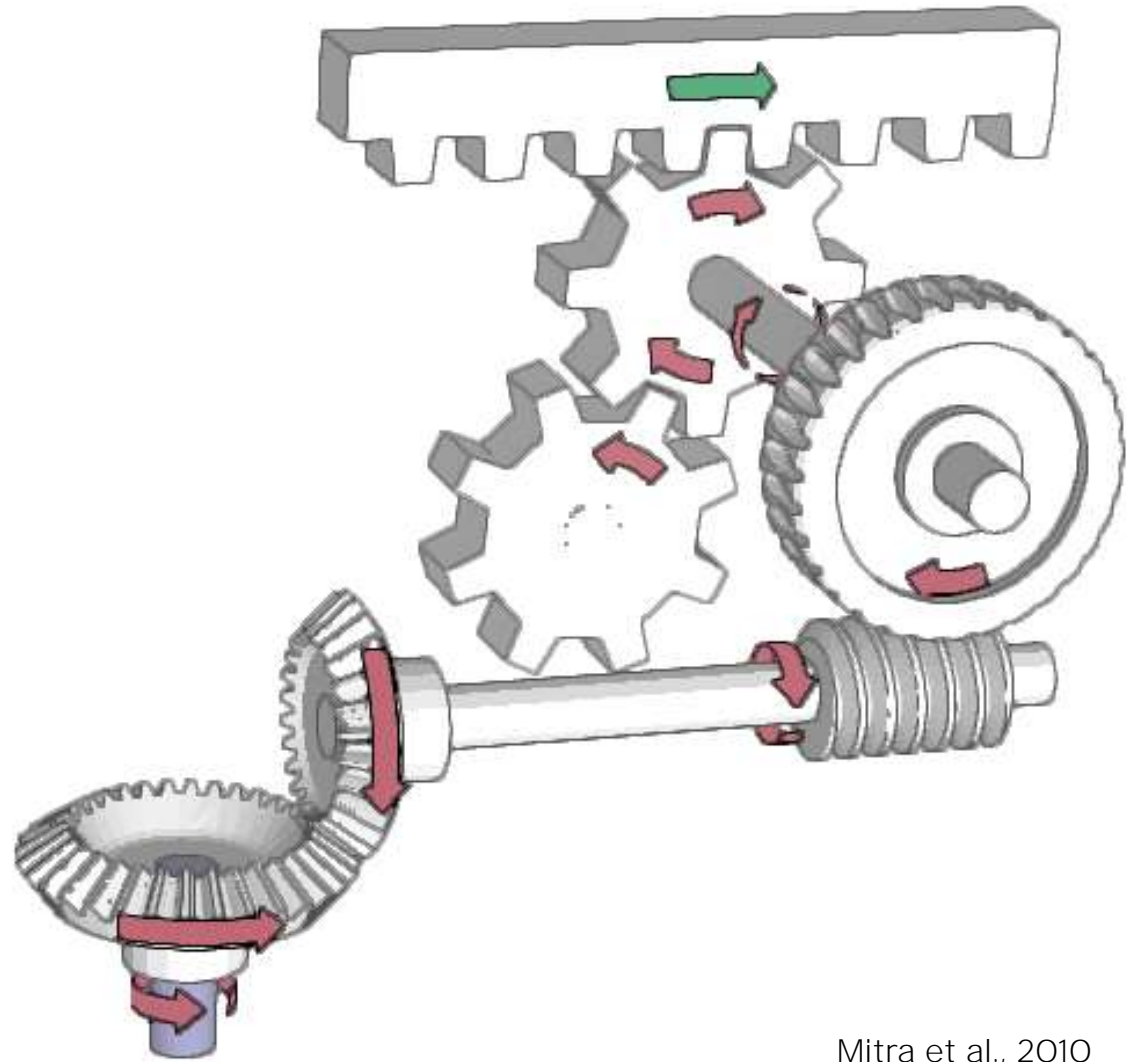
# EXPLOSION DIAGRAMS



# ASSEMBLY GUIDES & MECHANICAL PROCESSES

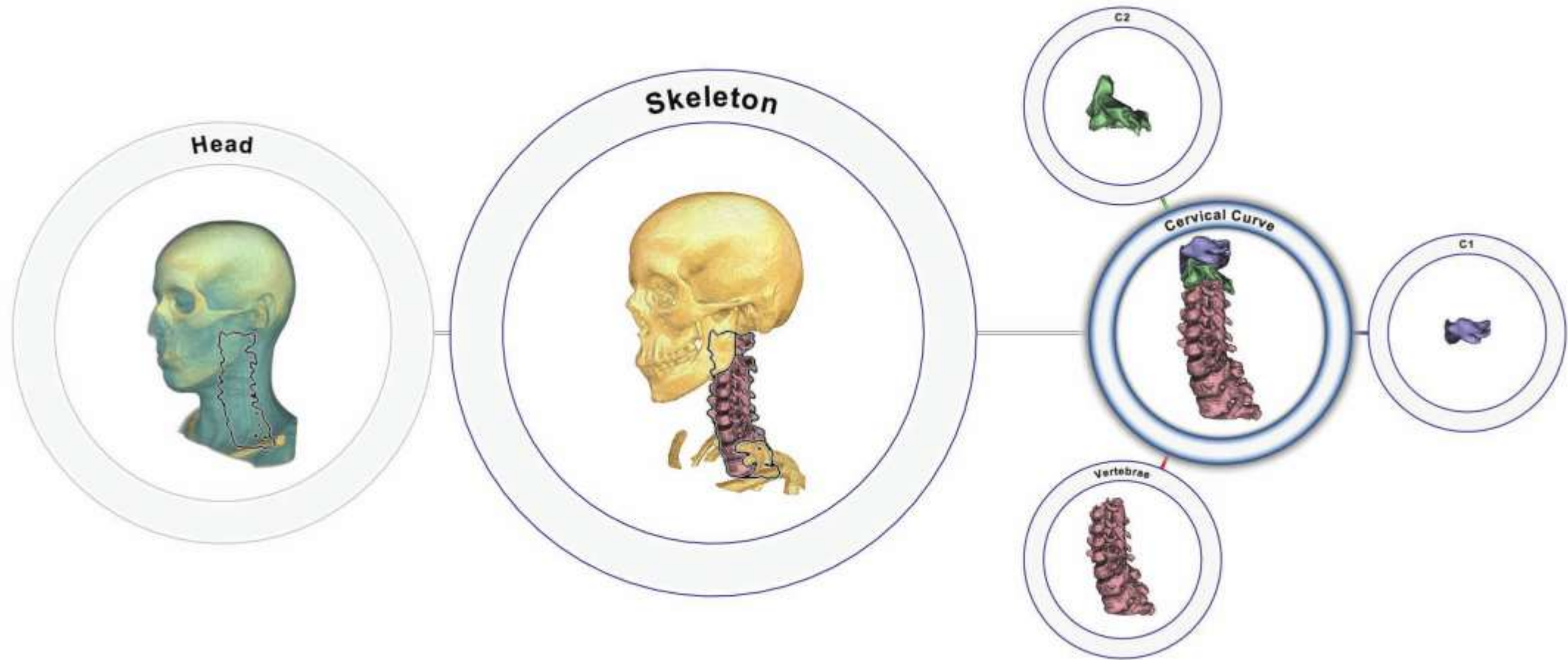


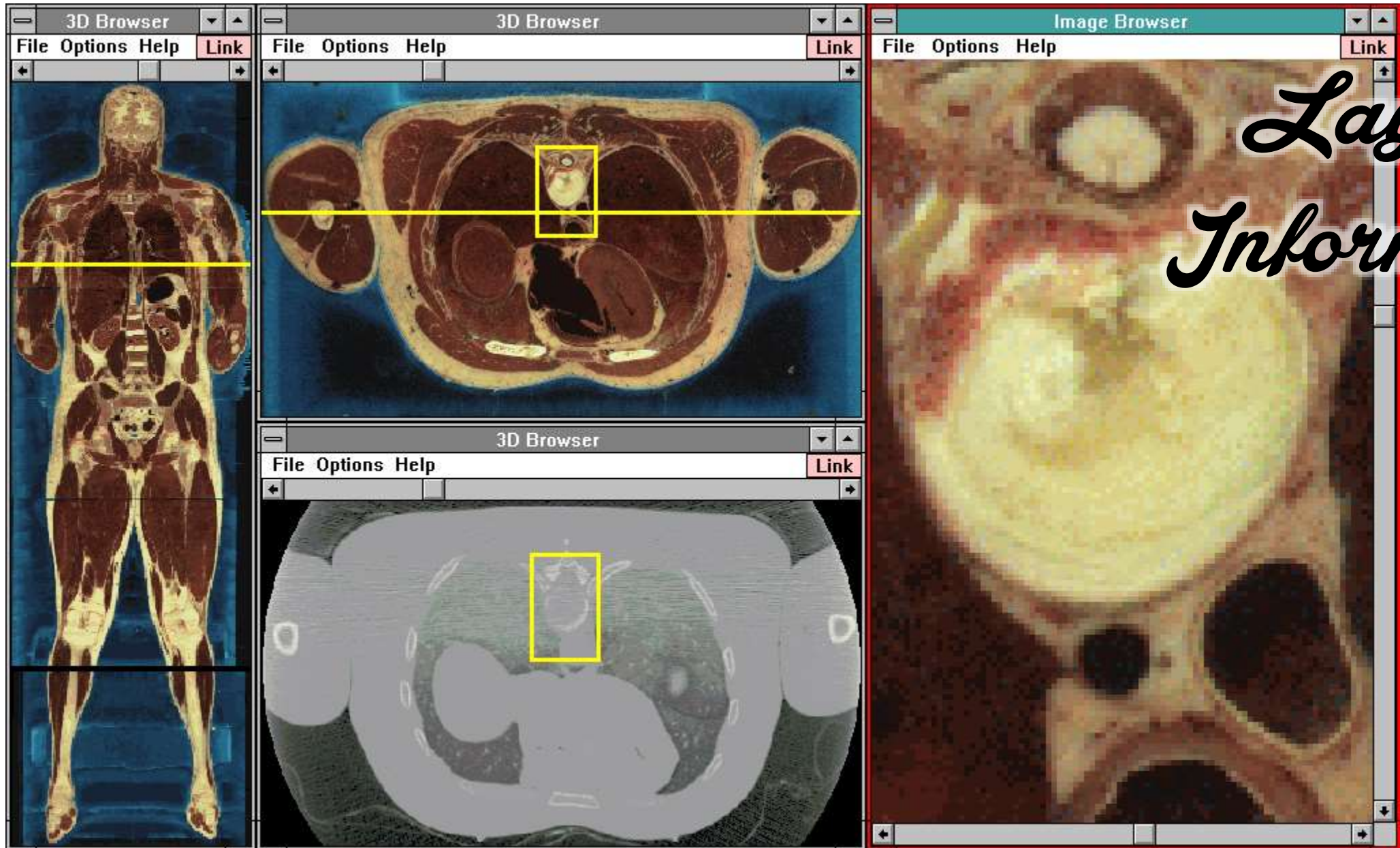
Agrawala et al., 2003



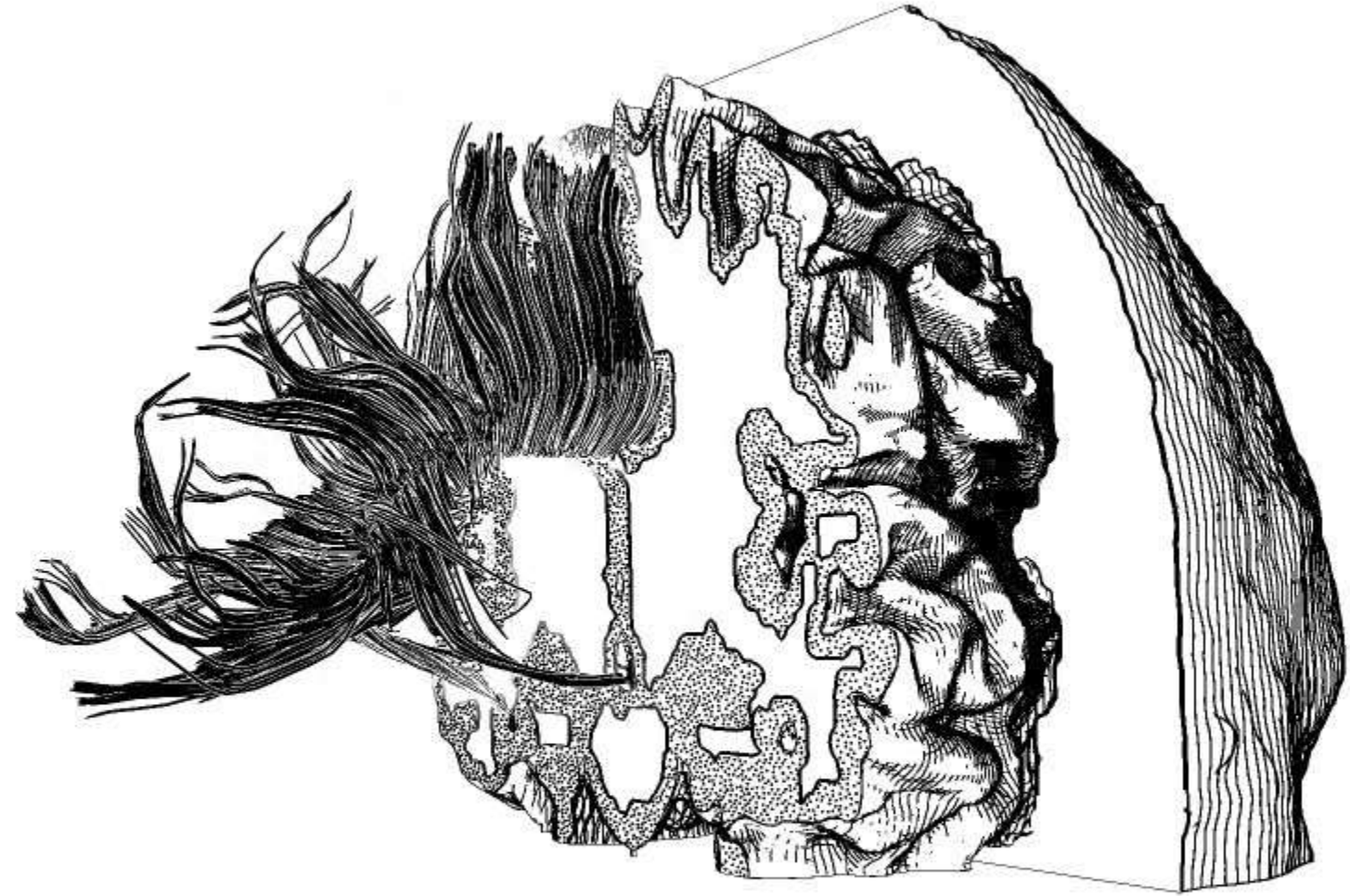
Mitra et al., 2010

# HIERARCHICAL ORGANIZATION





*Layers of Information*



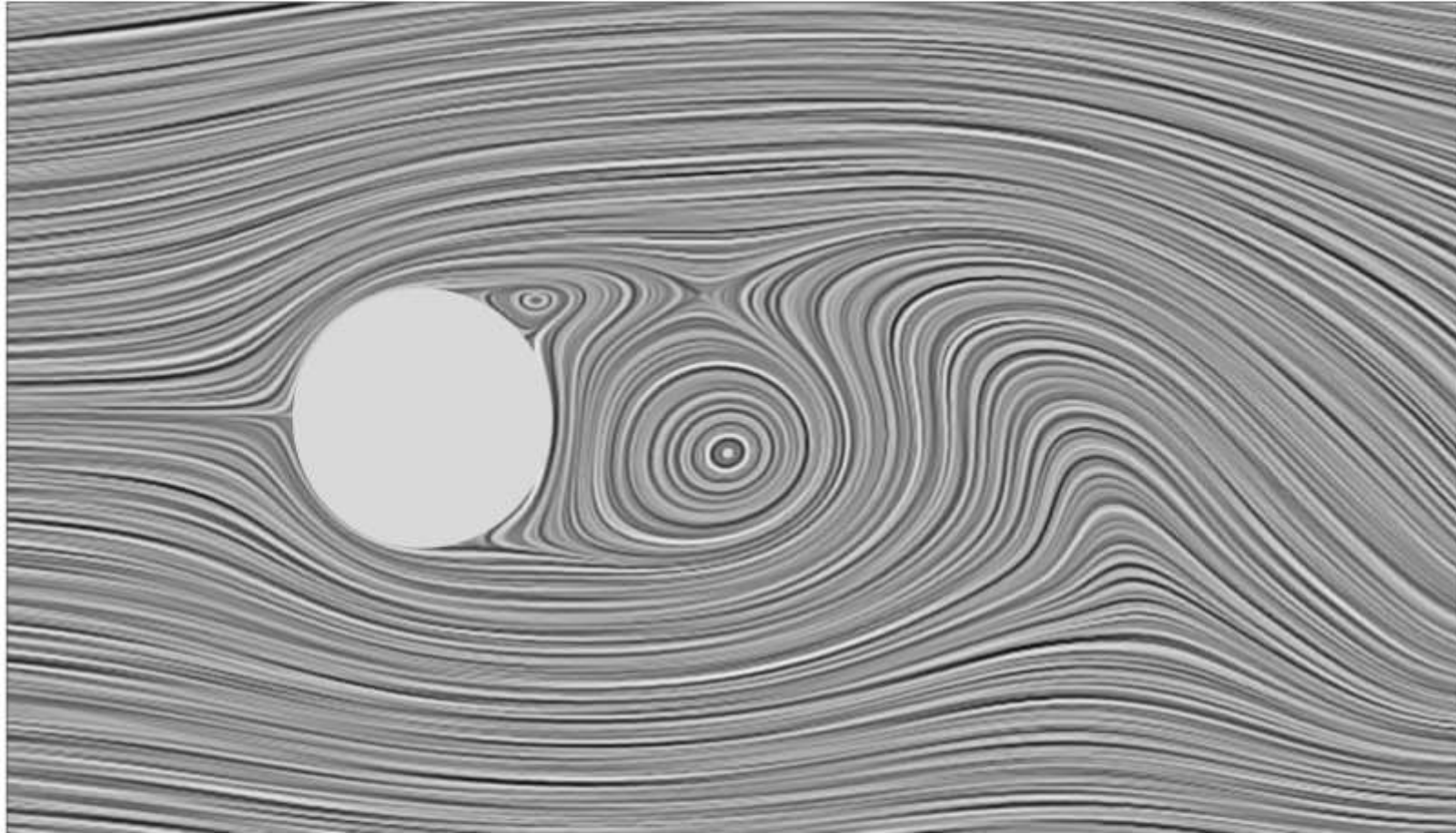


IVAR BACKPACKS

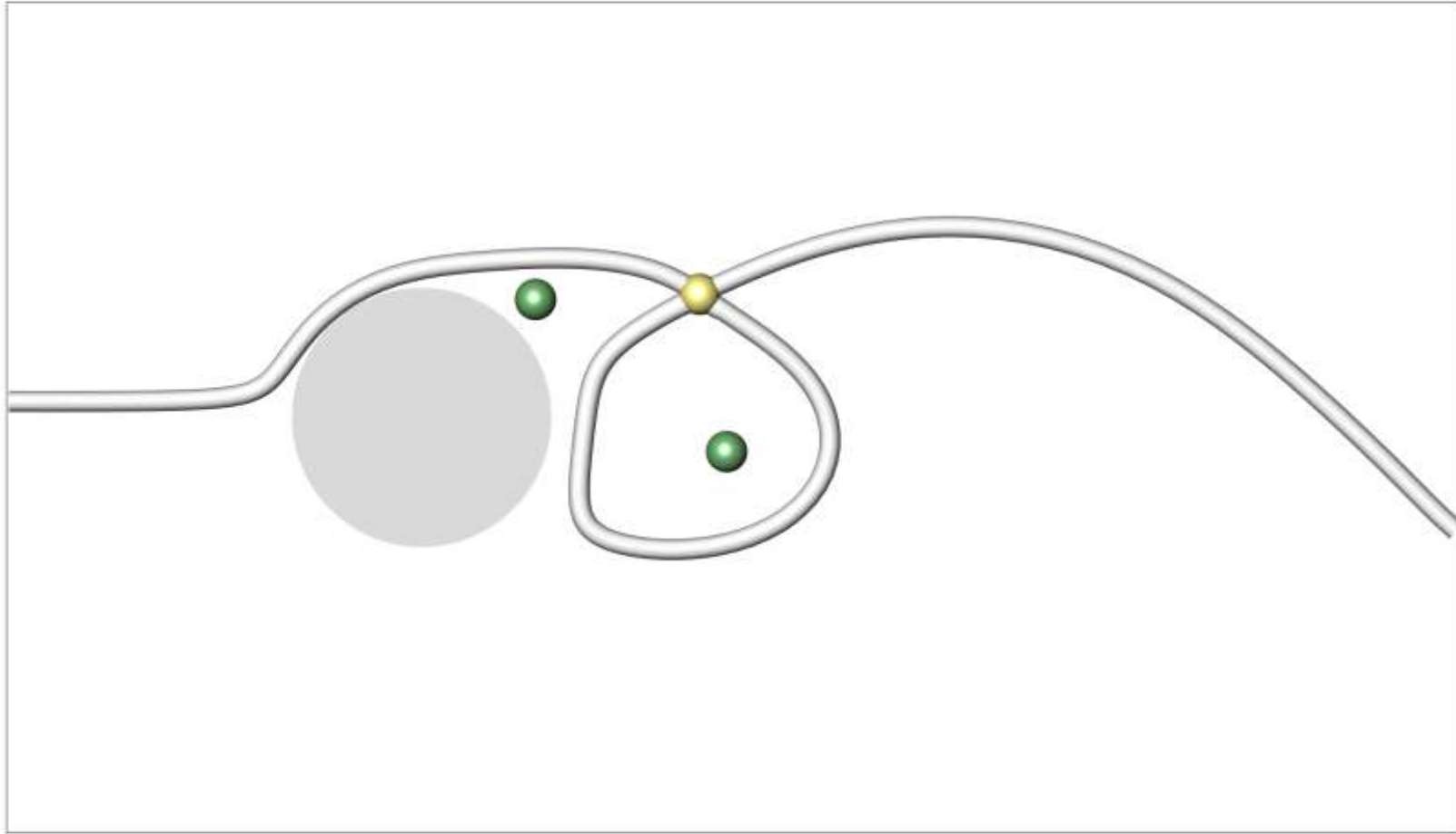




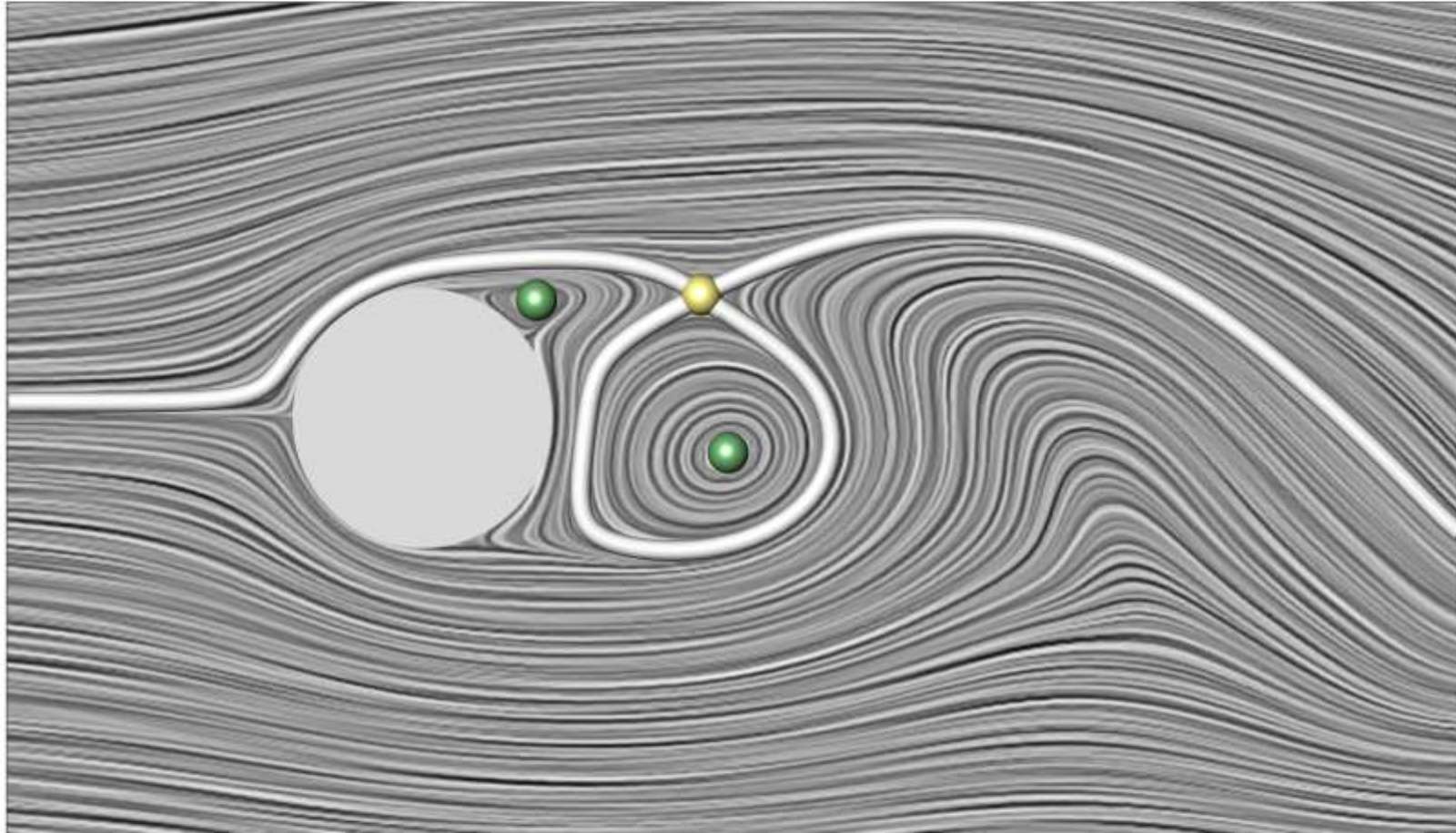
IVAR BACKPACKS



courtesy of Timo Weinkauf



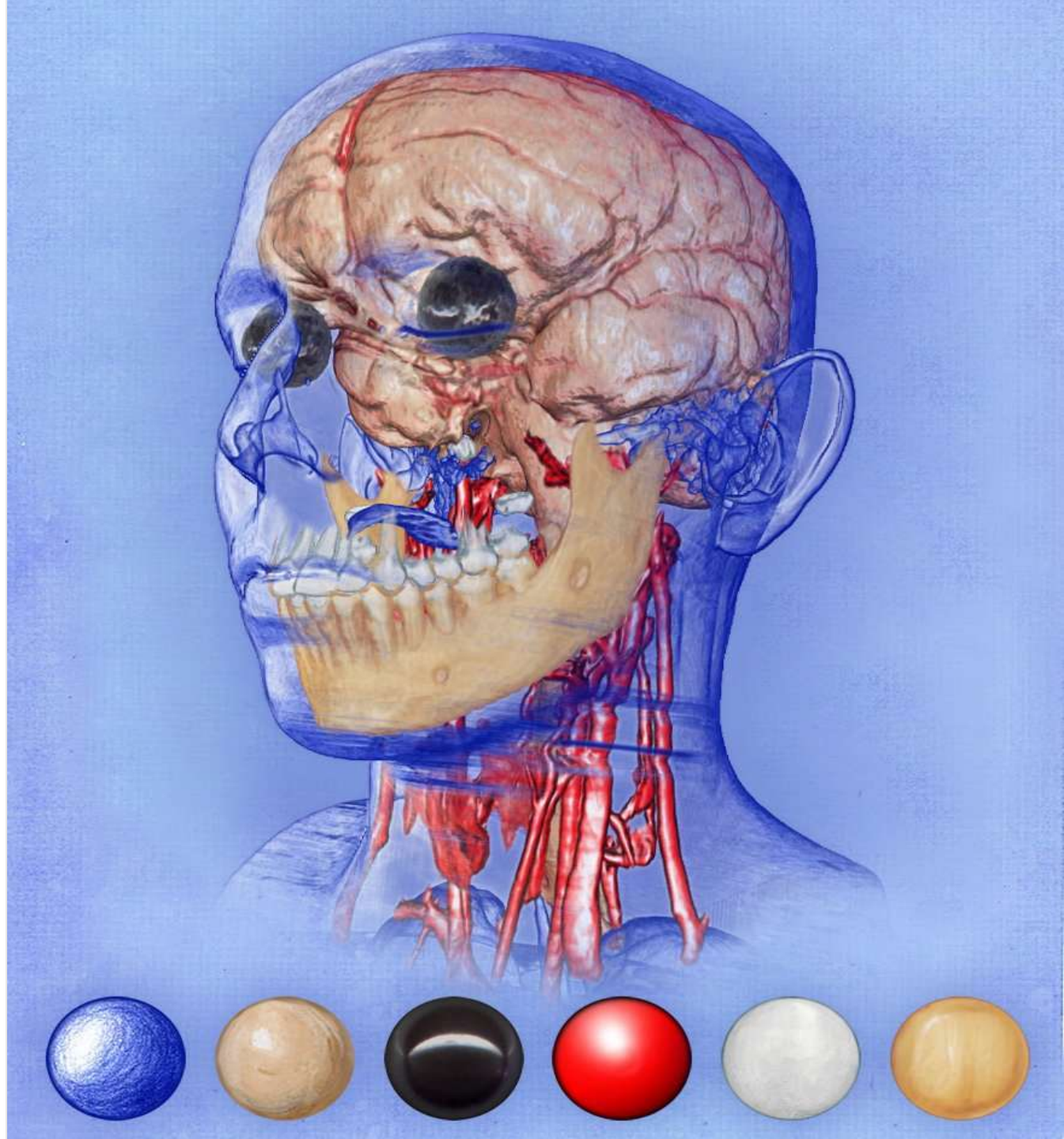
courtesy of Timo Weinkauff



courtesy of Timo Weinkauf



Bruckner and Gröller, 2007



# Stylization

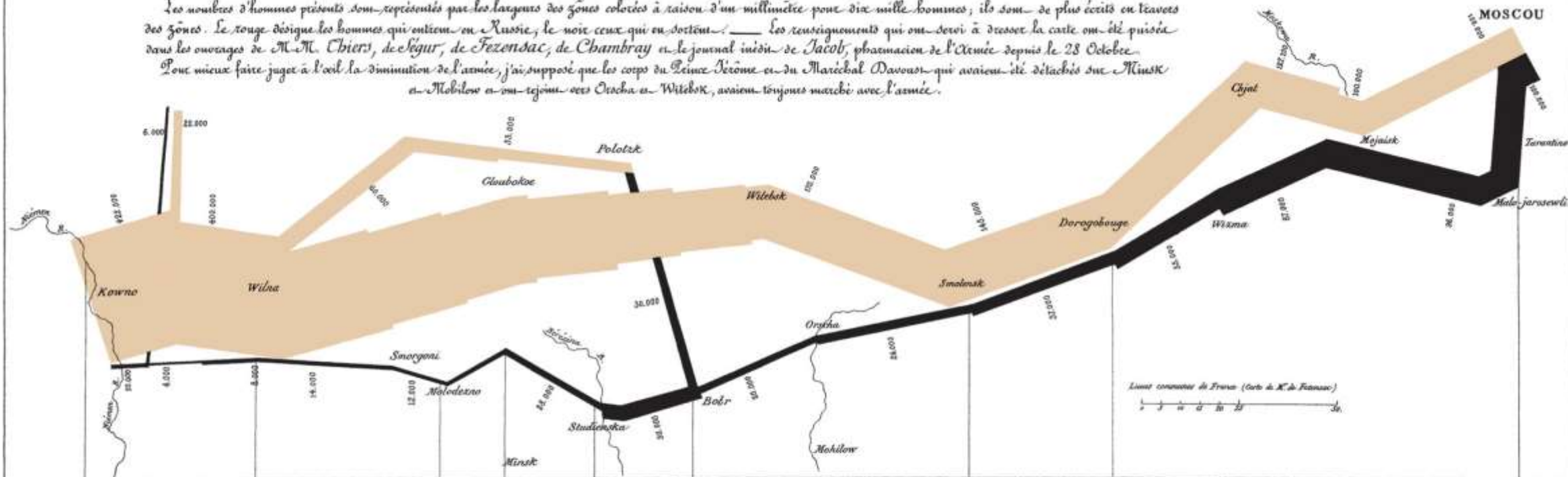
## Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite

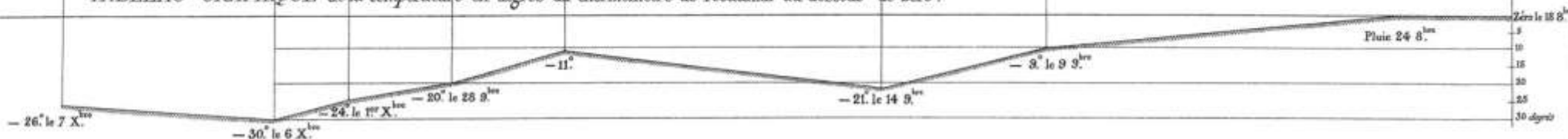
Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zones colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zones. Le rouge désigne les hommes qui ont été en Russie, le noir ceux qui en sont restés. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M. M. Chiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés sur Minsk et Mohilew et qui rejoignirent Orscha et Witebsk, avaient toujours marché avec l'armée.



### TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Les Cosaques passent au galop le Niémen gelé.

*A Gift*  
 An Online Edition  
 in the memory of  
 the great biography

Edited by  
 Margaret Cook,  
 Peter Dreyer,  
 Nancy Jones,  
 Peter Knapik,  
 Peter Knapik,  
 Charles Miller,  
 and Philip Miller,  
 with the help of  
 Mark Dreyer,  
 Daniel Goren,  
 John Goren,  
 Brian Hadden,  
 and the support of  
 Mike Haddad,  
 George Kim,  
 Jeffrey Korman, and  
 Alexander Matis.

**Calendar** At the right, five parallel rows depict scheduled events from JDT's journals from the year he devoted and even months. Vertical lines mark the time and the date and time of each event. Principal points of interest are represented by lines with small triangles and circles at the start, but also the duration of the event.

**Visages Undertaken** Each image is marked by a rectangle whose width marks the duration of the visual record. The vertical position of each mark represents the frequency of the visual duration. The horizontal line marks the length of the visual component in the frequency of the image.

**Employment of Social Media** Rows represent the number of pages and sites the year was devoted and developed for the social media services featured (represented by a pattern of small triangles) in JDT's journals (represented in solid yellow). Published lines indicate the annual total number of pages used throughout the course of the calendar and not just highlights pages of interest.

**Contributions to Repositories** Rows have represented the number of journal records entered upon the databases operated by JDT. All lines indicated here represent the annual total number of records each year in the course of a calendar year.

**Citations of His Work** Horizontal arrows represent the number of citations of JDT's work by others in the world. Each arrow represents an individual journal and the length of the arrow is each year's and signifies the total tally of citations of the work during that year. Vertical lines connect the citations to paper titles below. The horizontal color corresponds to the original line of publication and duration from one year to the next, in accord with the color of the bar at the base of the chart.

2007 2008 2009 2010 2011 2012 2013

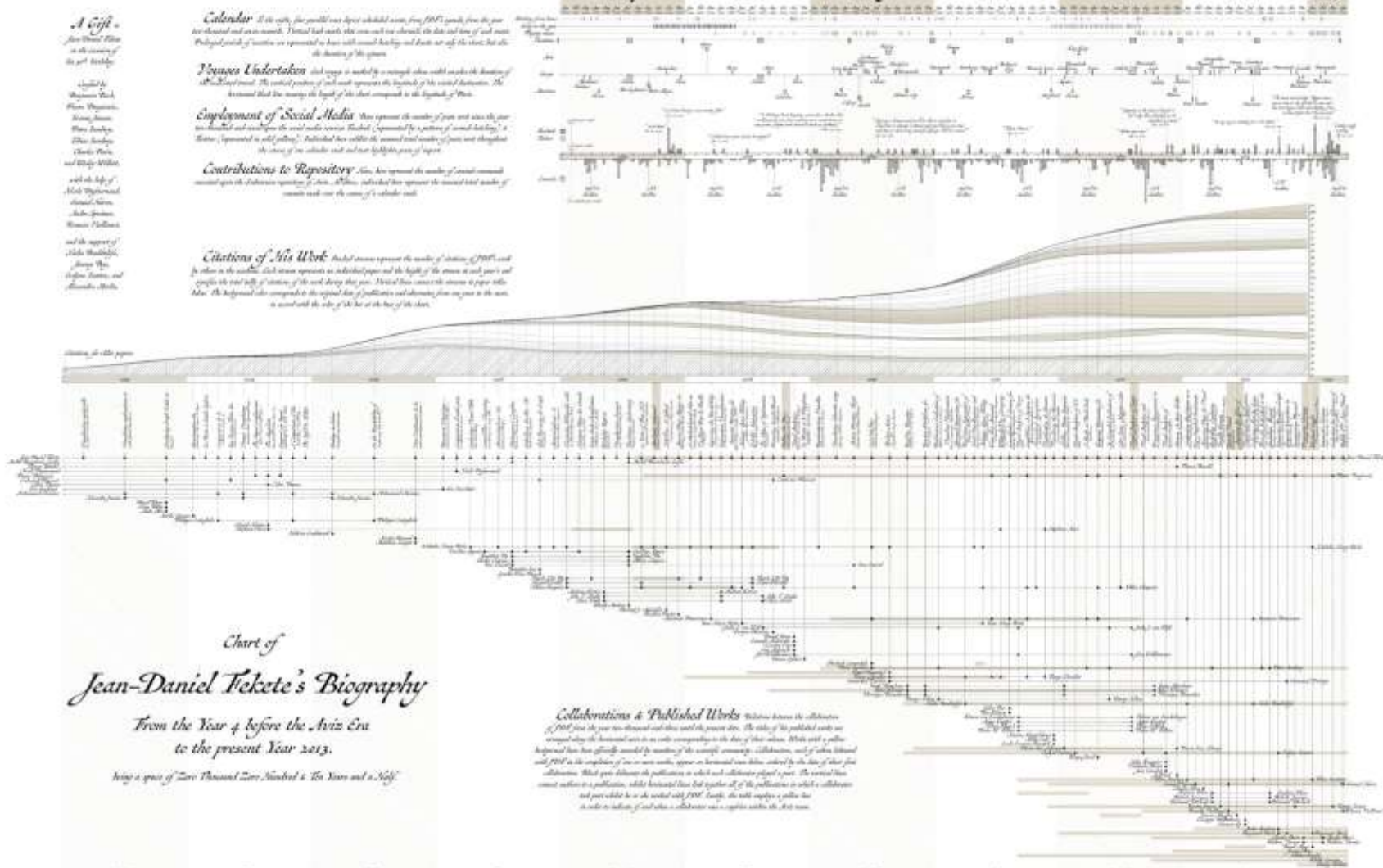


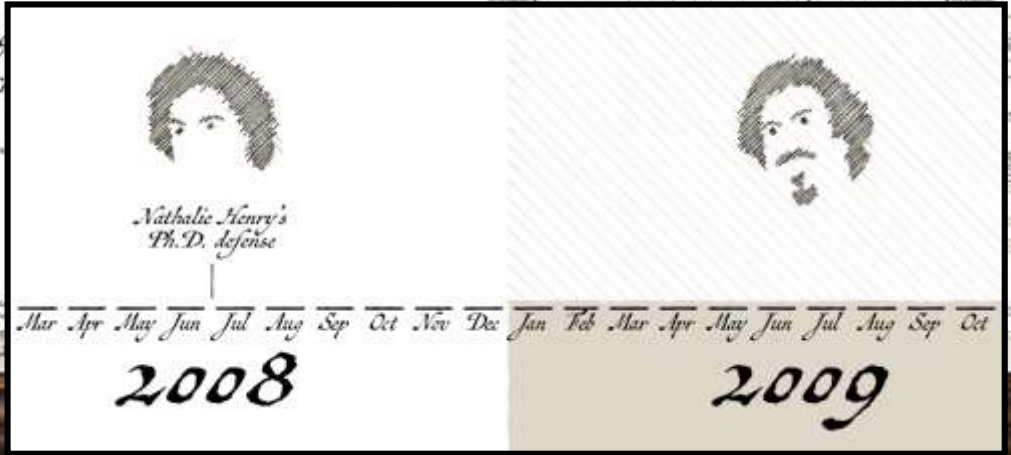
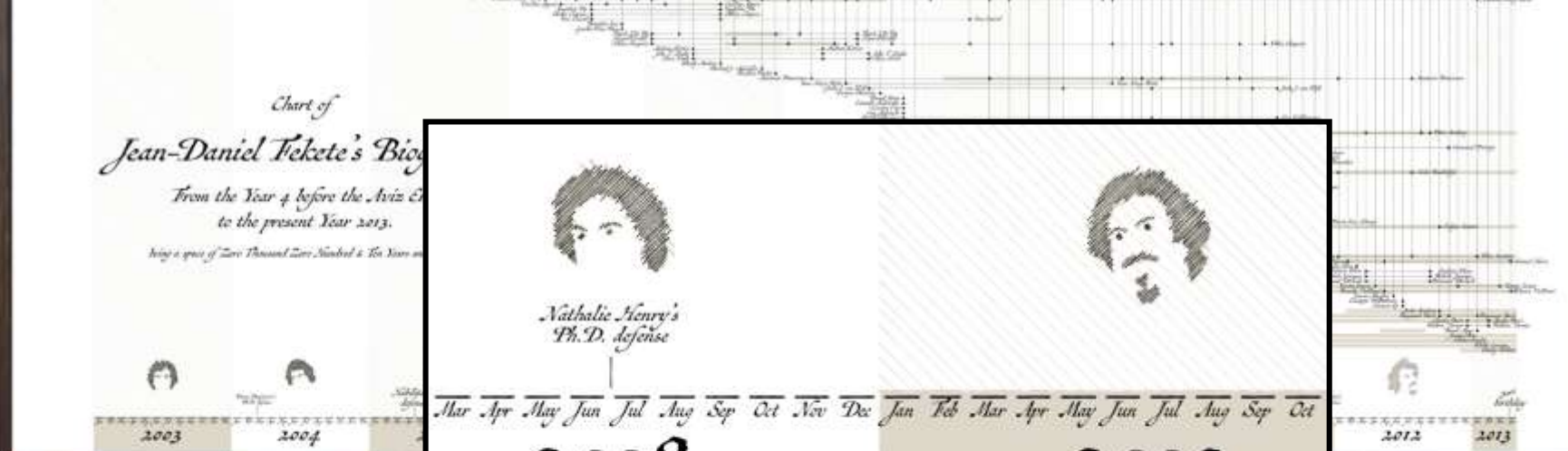
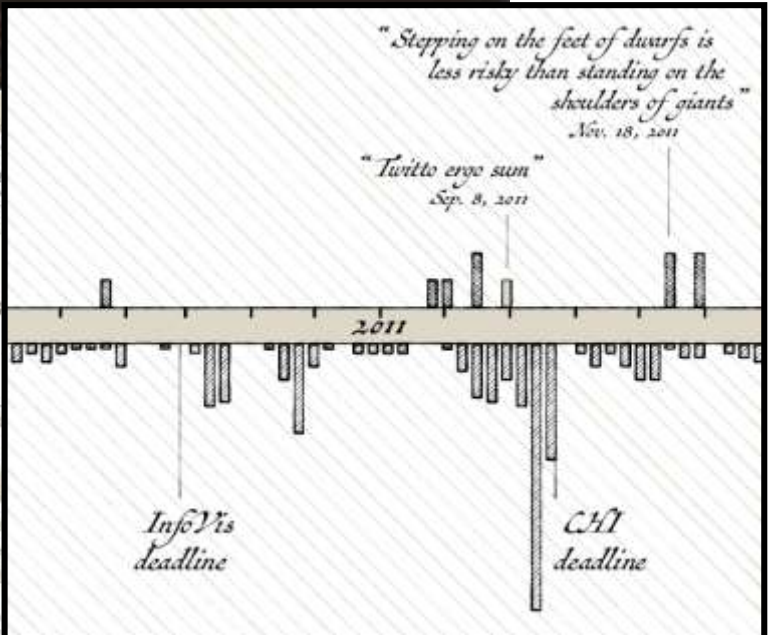
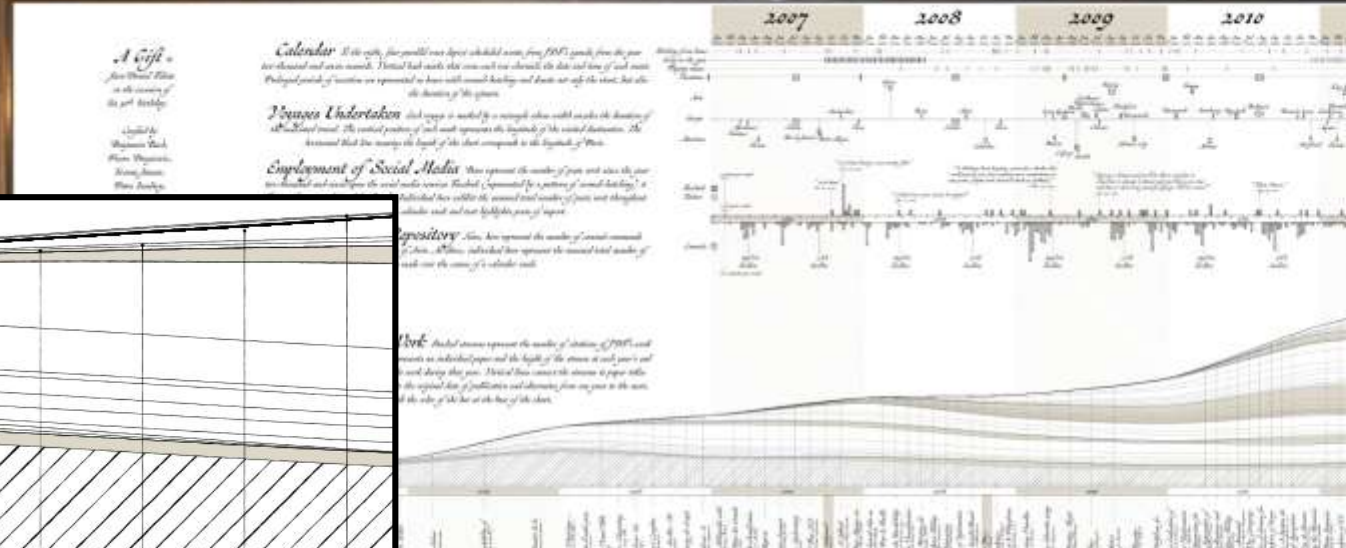
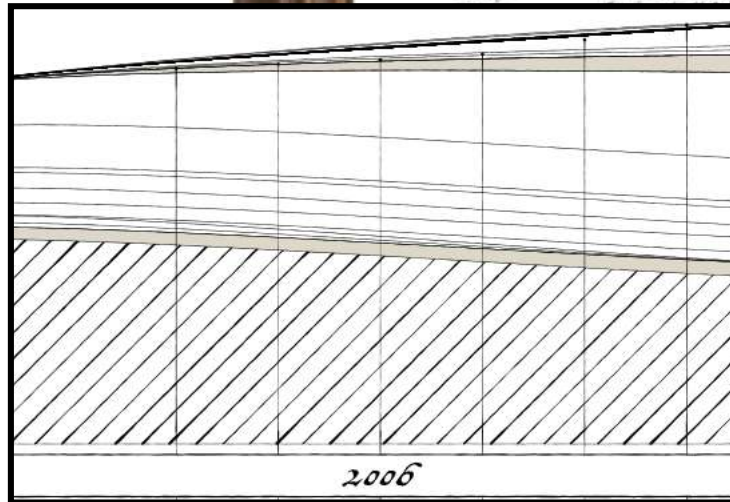
Chart of  
*Jean-Daniel Tékete's Biography*

From the Year 4 before the Aviz Era  
 to the present Year 2013.

Being a span of Two Thousand Two Hundred & Ten Years and a Half.

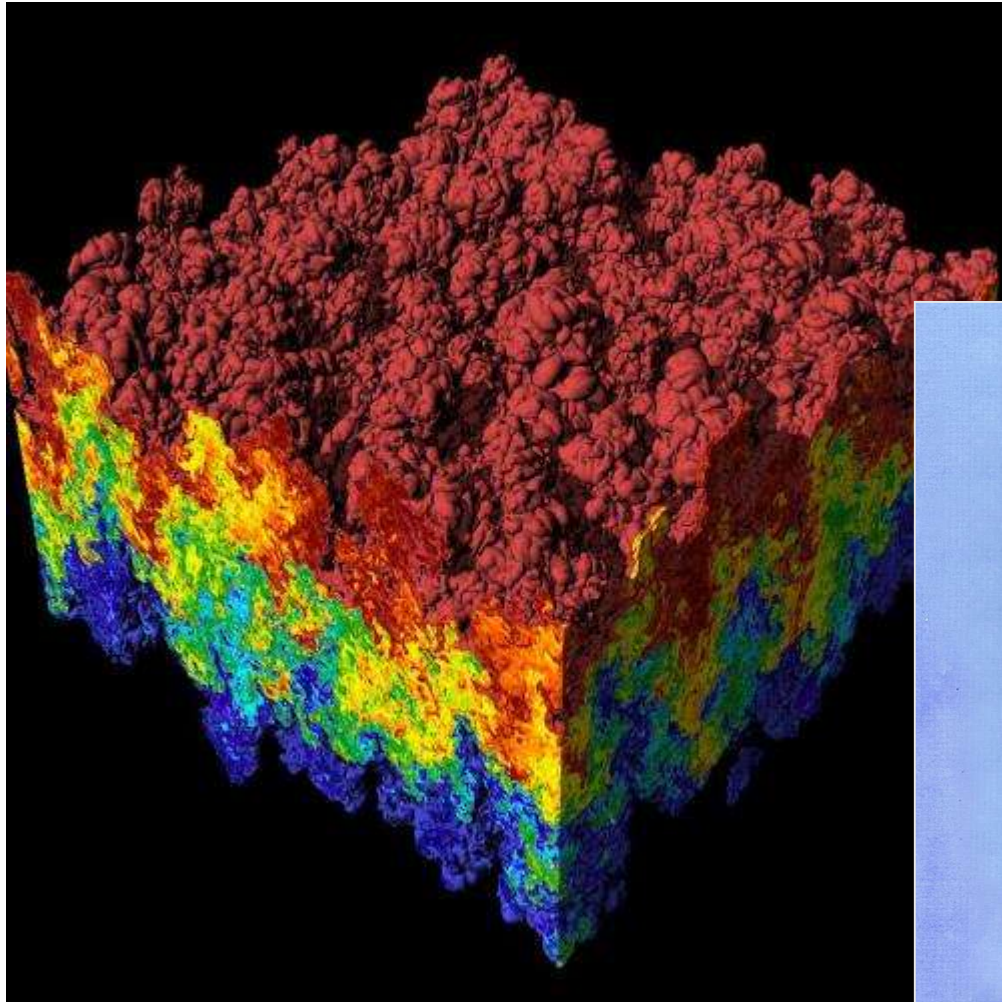
**Collaborations & Published Works** Relations between the publications of JDT from the year he devoted and also until the present day. The titles of the published works are arranged along the horizontal axis in an order corresponding to the date of their release. Works with a yellow background have been officially marked by members of the scientific community. Collaborations, most of which JDT had JDT in the completion of one or more works, appear on horizontal lines below, colored by the date of their first publication. Black gaps between the publications in which each collaboration played a part. The vertical lines connect authors to a publication, while horizontal lines link together all of the publications in which a collaboration and particularly in the central with JDT. Finally, the white empty space below the horizontal axis is reserved for the date of each collaboration and a signature within the 2013 year.

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013





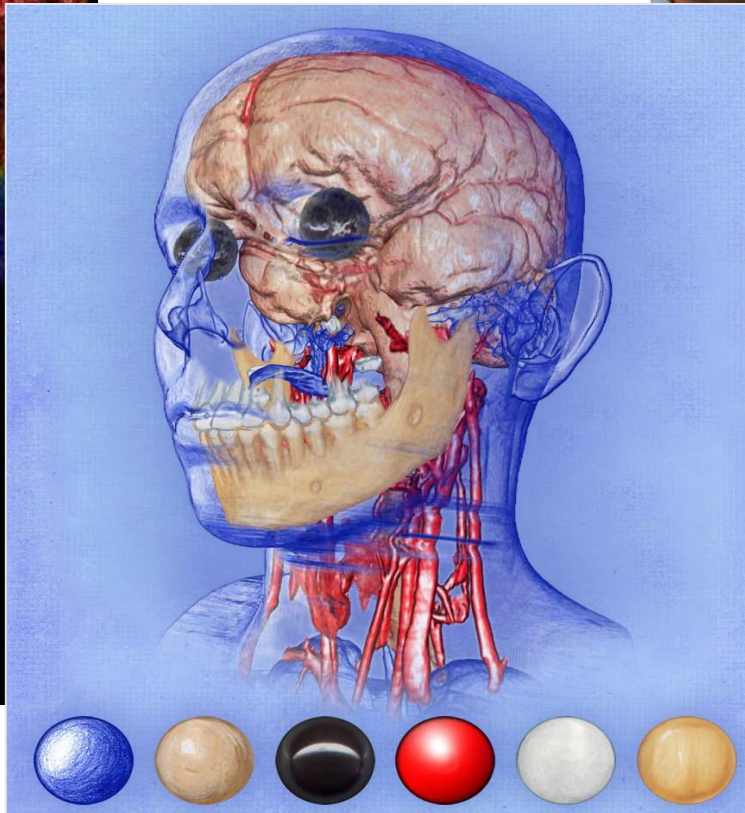
# *IluVis* VS. VISUALIZATION & ILLUSTRATION



Lawrence Livermore National Laboratory

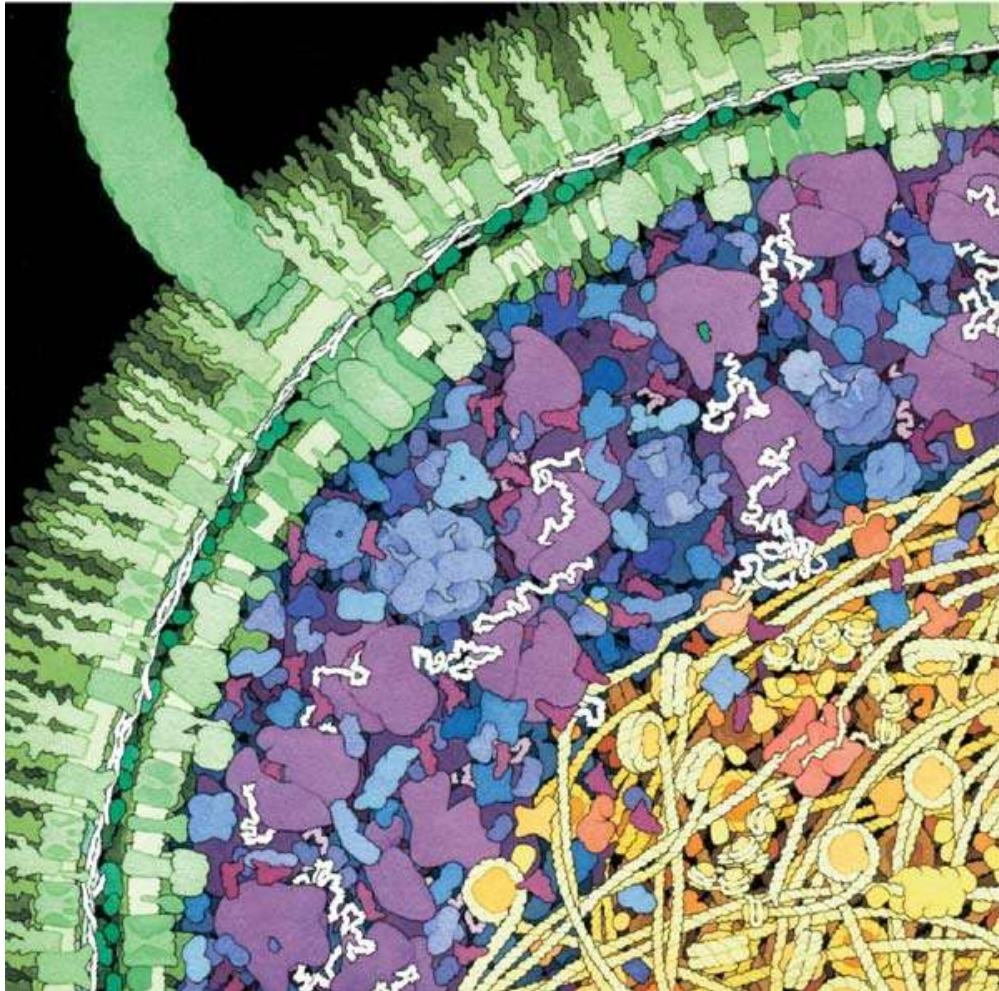


courtesy of Bill Andrews

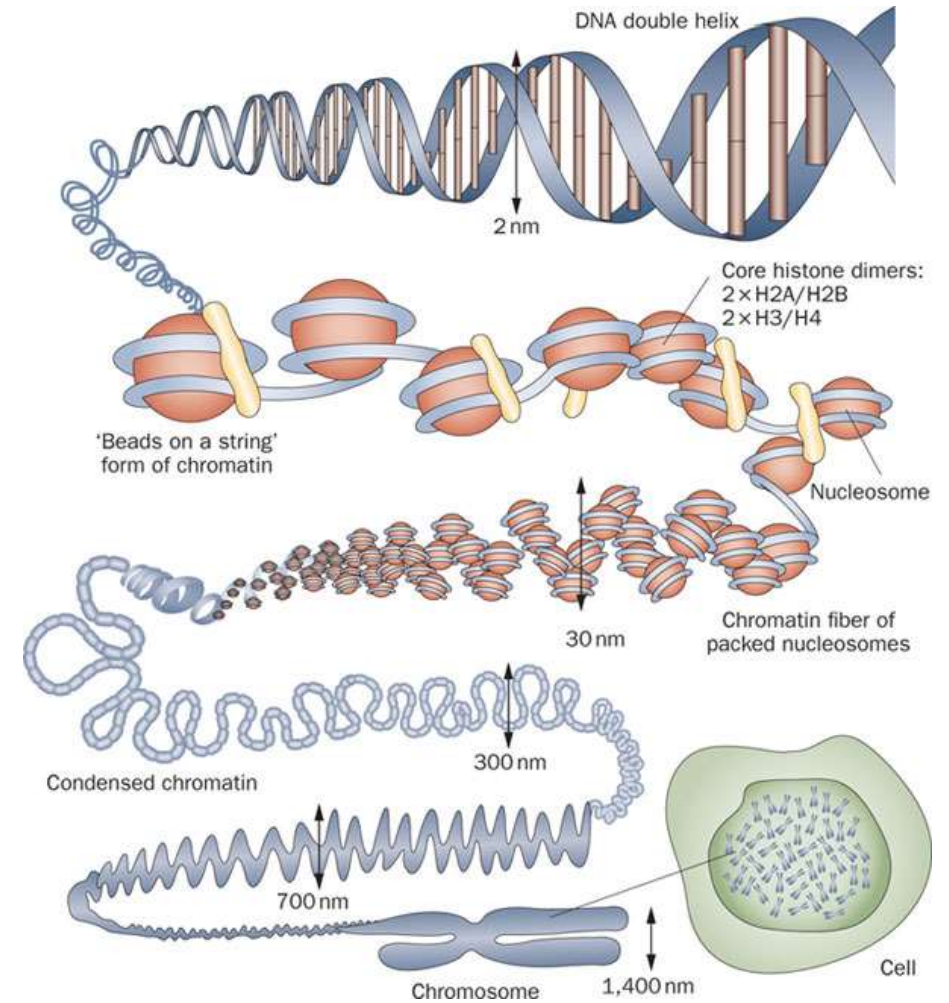


Bruckner and Gröller, 2007

# FUTURE CHALLENGES: ABSTRACTION



Goodsell, 2005

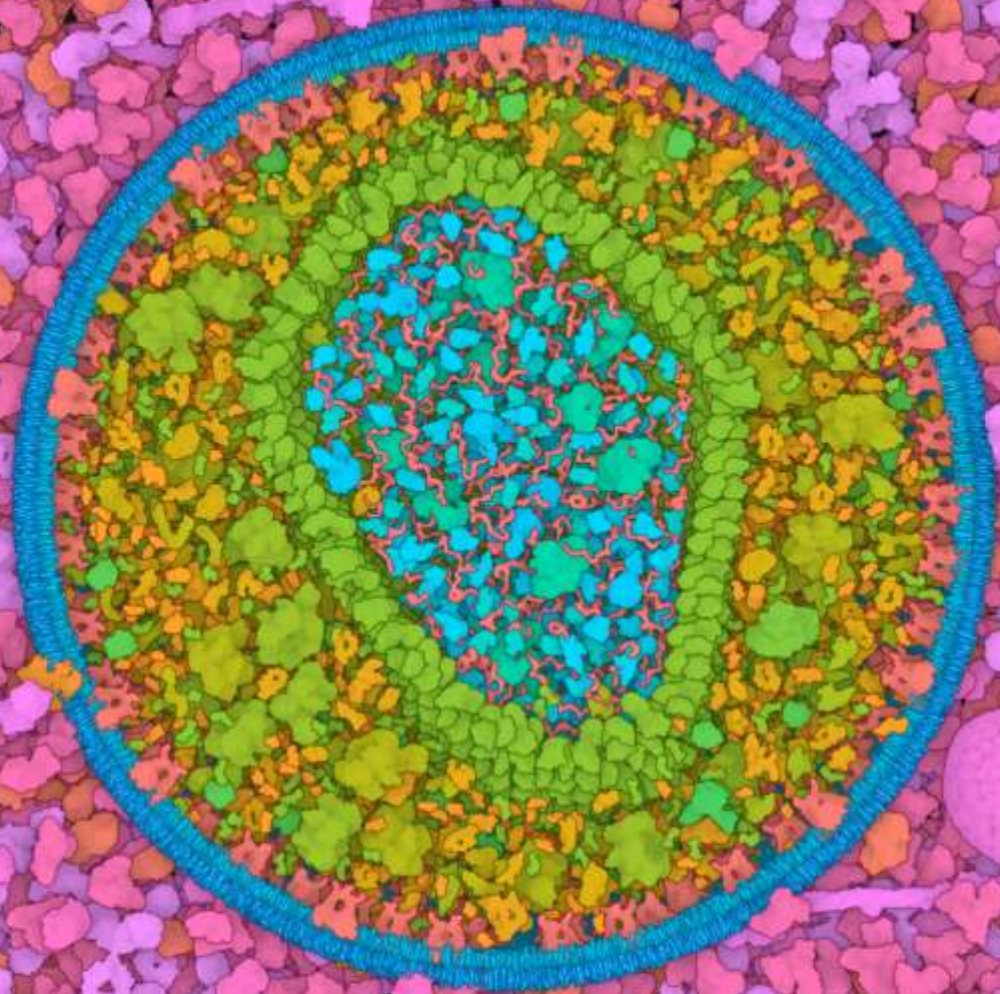


Tonna et al., 2010

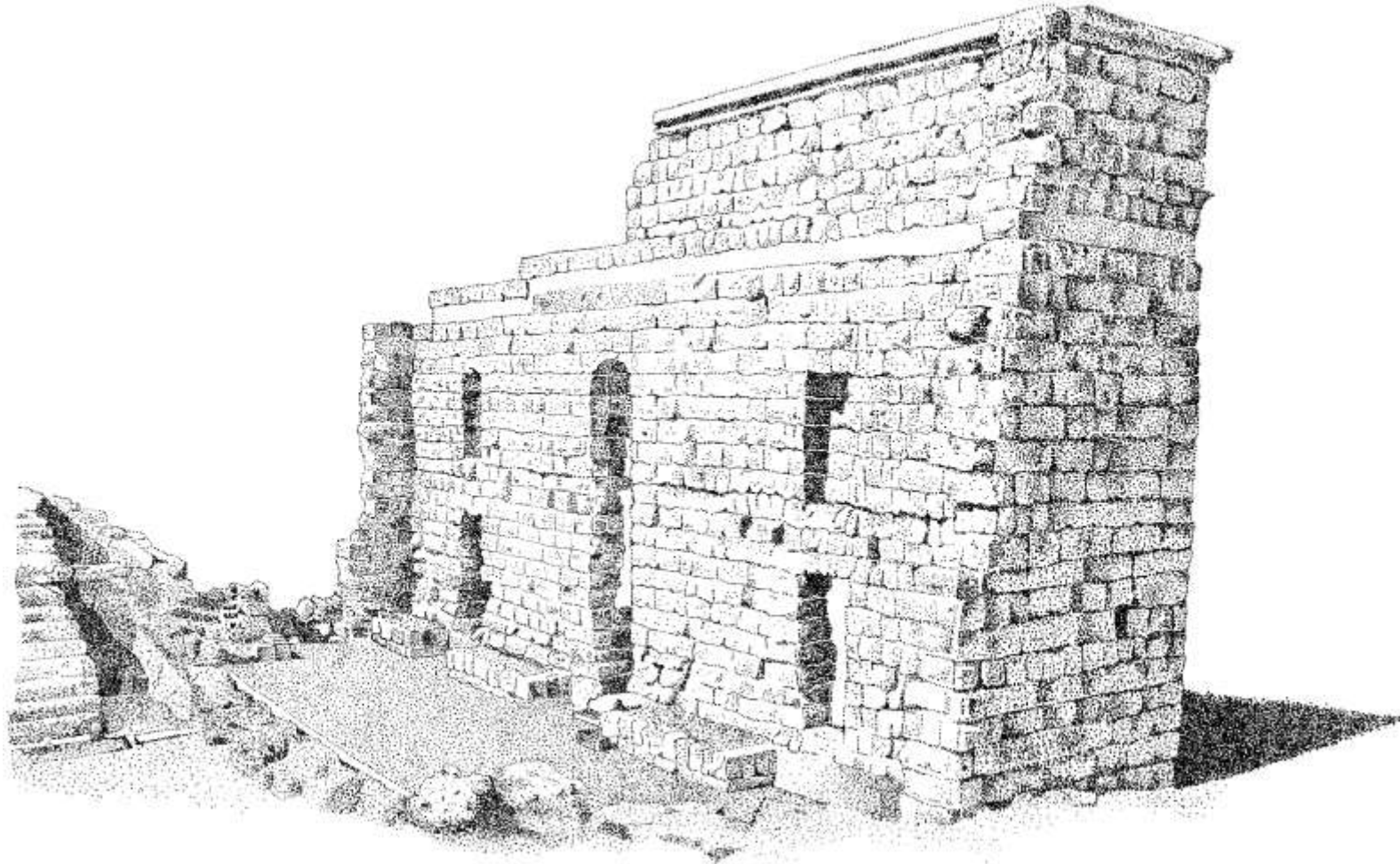
# FUTURE CHALLENGES: TOOLS

The background of the slide is a stylized map. It features a complex, dense network of thin orange lines that resemble a road network or a data flow map. These lines are overlaid on a background of irregular green and brown patches, suggesting natural features like parks, forests, or urban planning zones. The overall aesthetic is clean and modern, typical of digital mapping software.

# FUTURE CHALLENGES: TOOLS



# FUTURE CHALLENGES: TOOLS



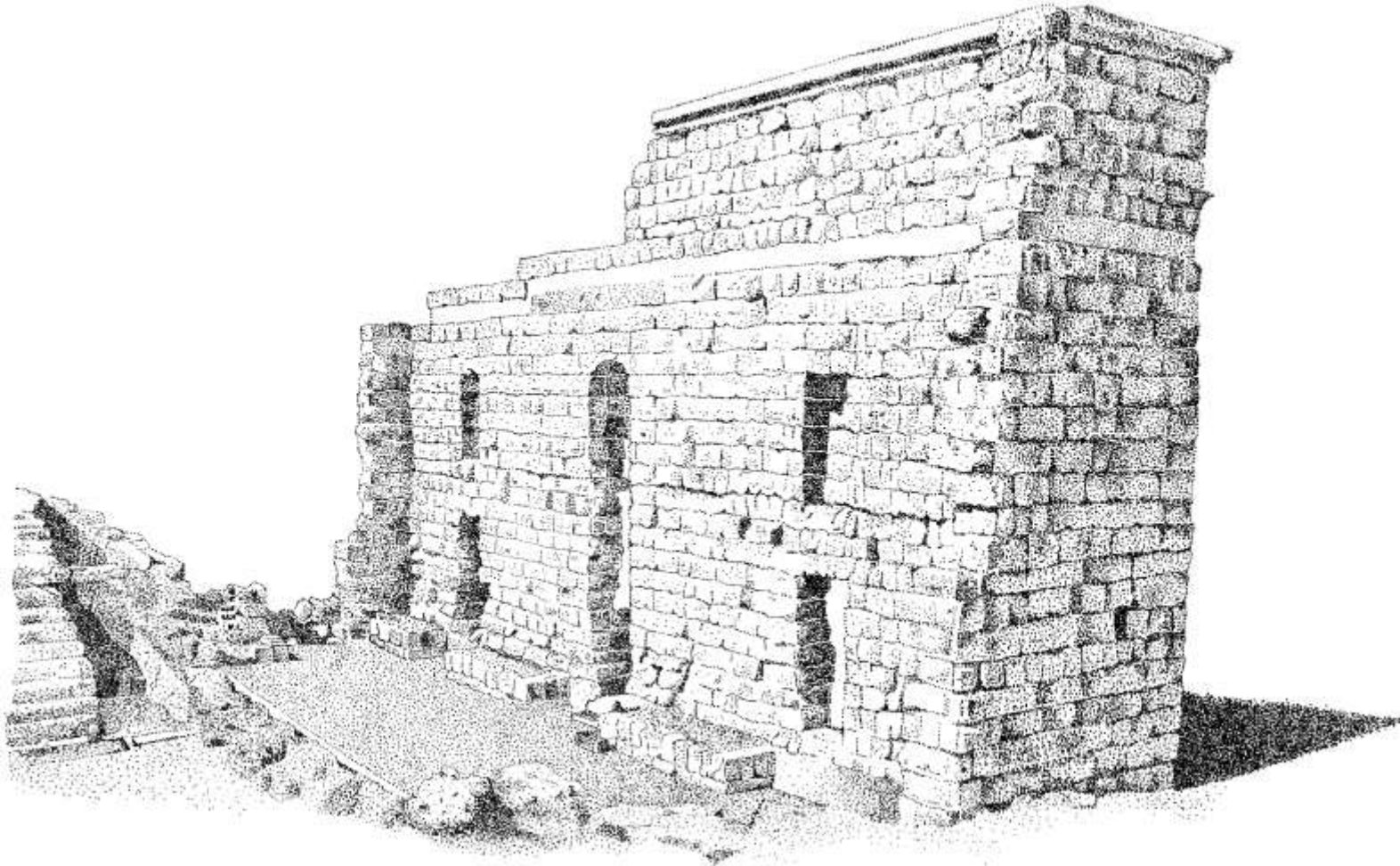
# FUTURE CHALLENGES: TOOLS



# FUTURE CHALLENGES: TOOLS



# FUTURE CHALLENGES: TOOLS







TOBIAS ISENBERG

*Illustrative*

**VISUALIZATION**

# Sources

- lecture by Lora Oehlberg
- many scientific papers
- other sources that are named