Relief depiction

Depiction of relief/terrain/topography is more complex than other elements

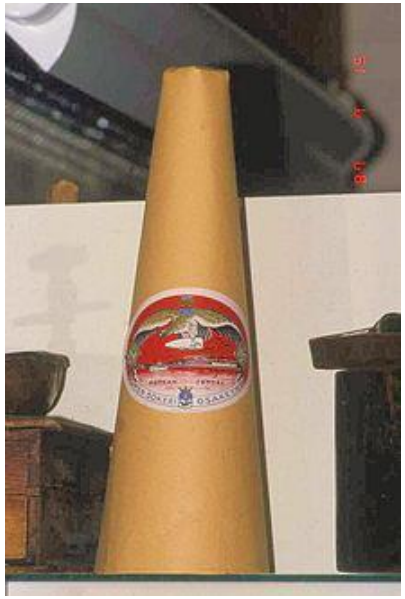
Relief / terrain / topography

- a third dimension (height) that varies continuously over space
- has several components: e.g. height, slope, shape, aspect
- can be depicted using: points, lines, or areas (~ 10 options)
- they vary in how effective they are visually / quantitatively
- Often the major visual map component and affects the other elements

1. Sugar loafs

Idealized depictions from a side or oblique view; the only form of topography on maps pre-1800

A sugarloaf was the traditional shape of sugar in the eighteenth century: a semi-hard sugar cone that required a sugar axe or hammer to break it up



Modern use of sugar loafs: when only a rough idea of hills/mountains is needed

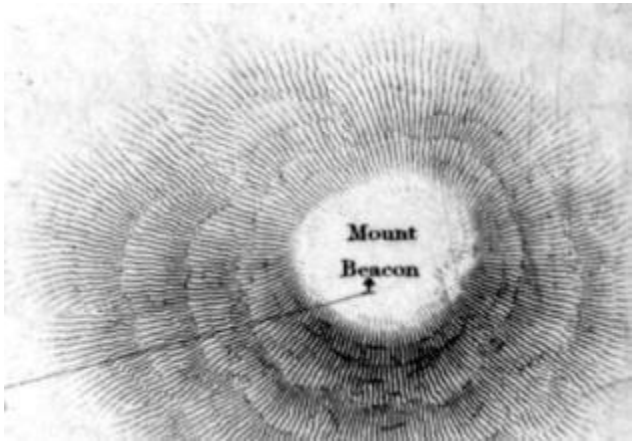
2. Hachures

- **lines of varying width and length**, drawn along steepest slope.

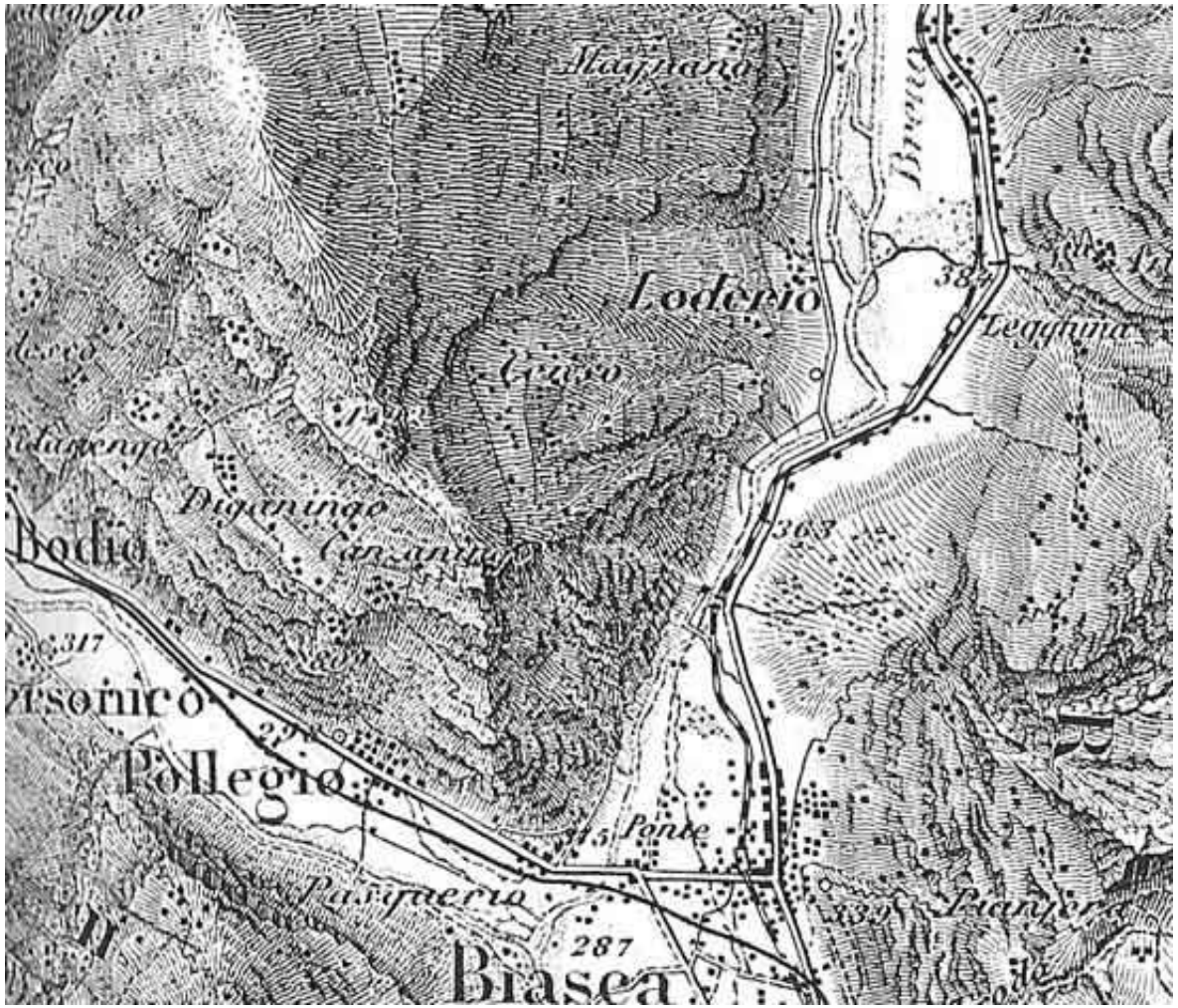
- main type of relief depiction 18th-19th century, no exact heights …

1800: only 50 mountain heights were plotted worldwide

1799: hachures formalized to equate line thickness with slope



Oblique illumination could be added for more visual effect – but losing a direct measure of slope to thickness



Disadvantages

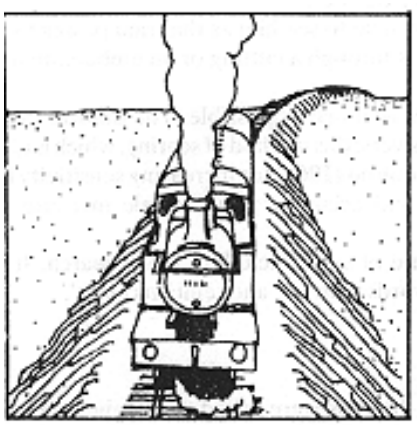
- time-consuming to produce, can obscure other information
- not very effective except in mountainous terrain
- Replaced in twentieth century with spot heights and contour lines

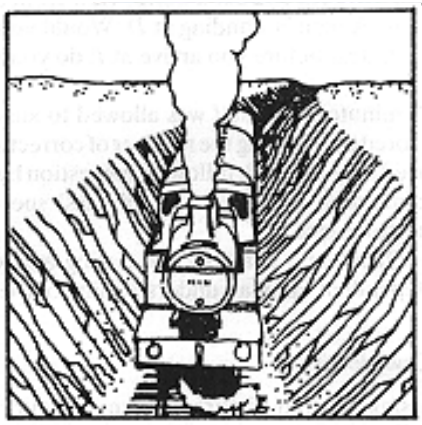
Continuing use of hachures

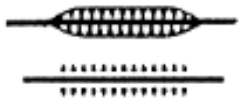
Steep enbankments

Mountain cliffs

http://www.richardphillips.org.uk/maps/symbols.html







http://www.gitta.info/TopoCart/en/html/ContTopo_learningObject2.html

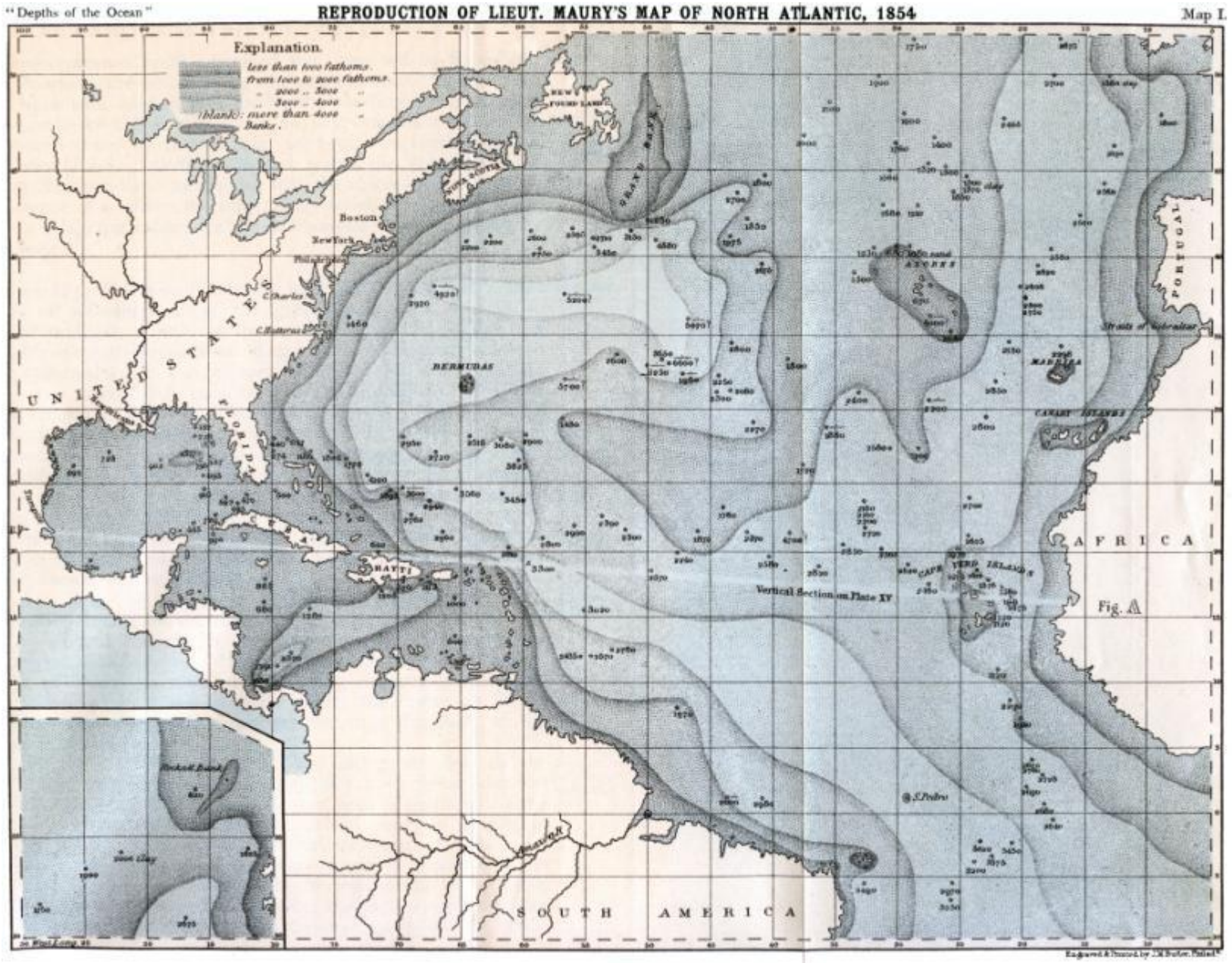
3. Spot heights ……after 1800

exact elevations enabled by surveying

A base for mapping – not an effective display method

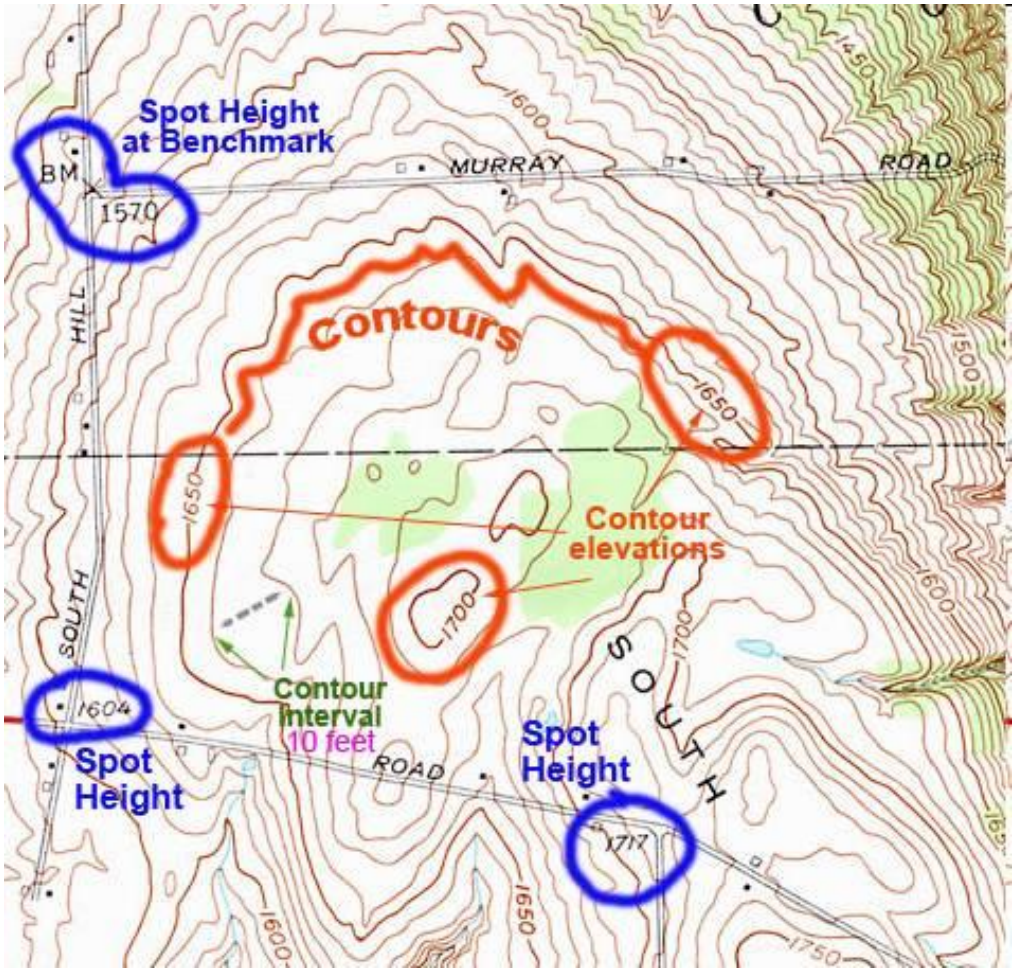
.205 .203 .255 .235 .217 .220 .309 .208 .243 .311 .339 .344 .306 .270 .274 .330 .290 .308 .270 .290 .244 .202 .212

4. **Contours:** e.g. bathymetric contours (1854) - <u>isobaths</u>



Accurate surveying of elevations (in Canada) was developed in the late 19th century, contouring became the main method in the 20th century.

A contour is a type of **isoline (isohype)** : line of equal elevation values



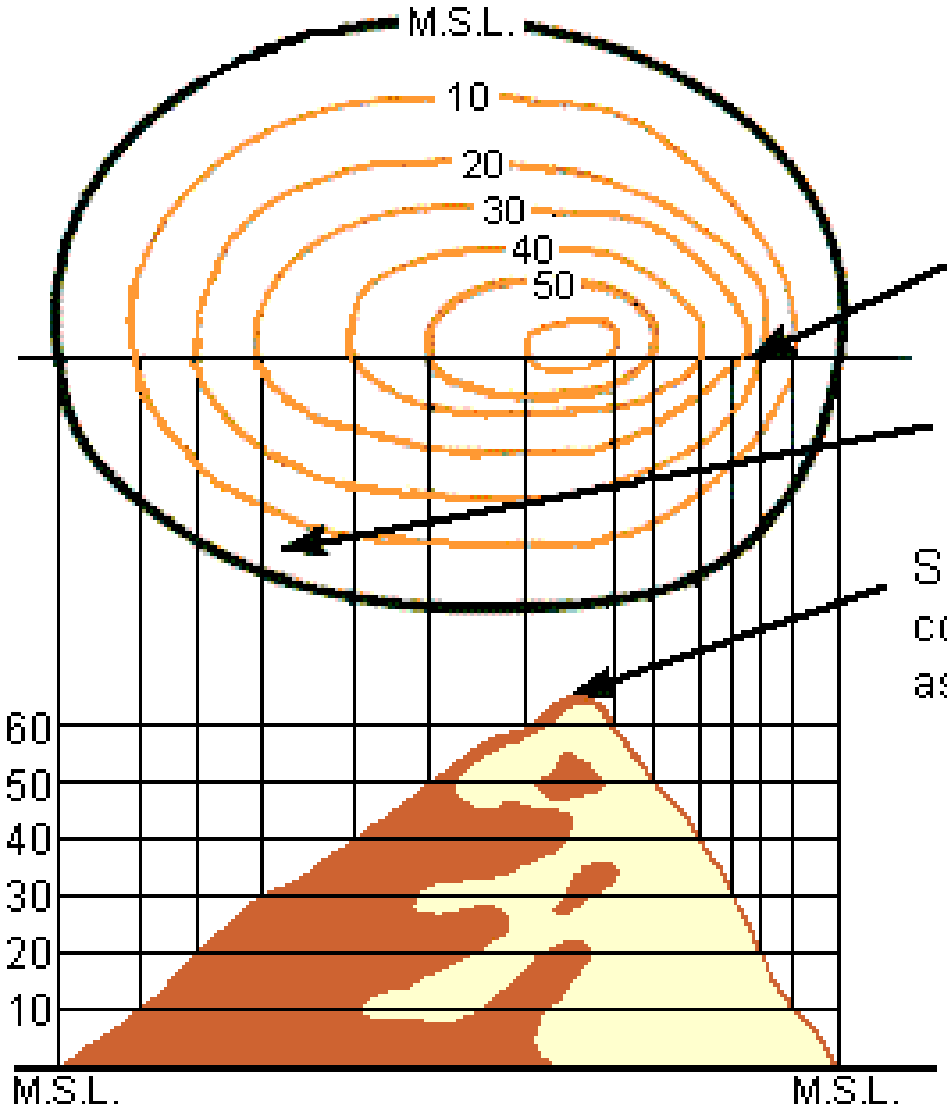
- Index contours – every 5th contour
- Supplemented with spot heights

Contours mapped from Surveying and stereo-aerial photography

Identified in legend with contour interval (m)

http://ublib.buffalo.edu/libraries/asl/maps/cat/images/contours-spot.jpg

Interpreting contours



When close together, contour lines indicate a steep slope.

When far apart, contour lines indicate a gentle slope.

Spot elevations are heights between contour lines, and are shown on a map as dots with a value beside them.

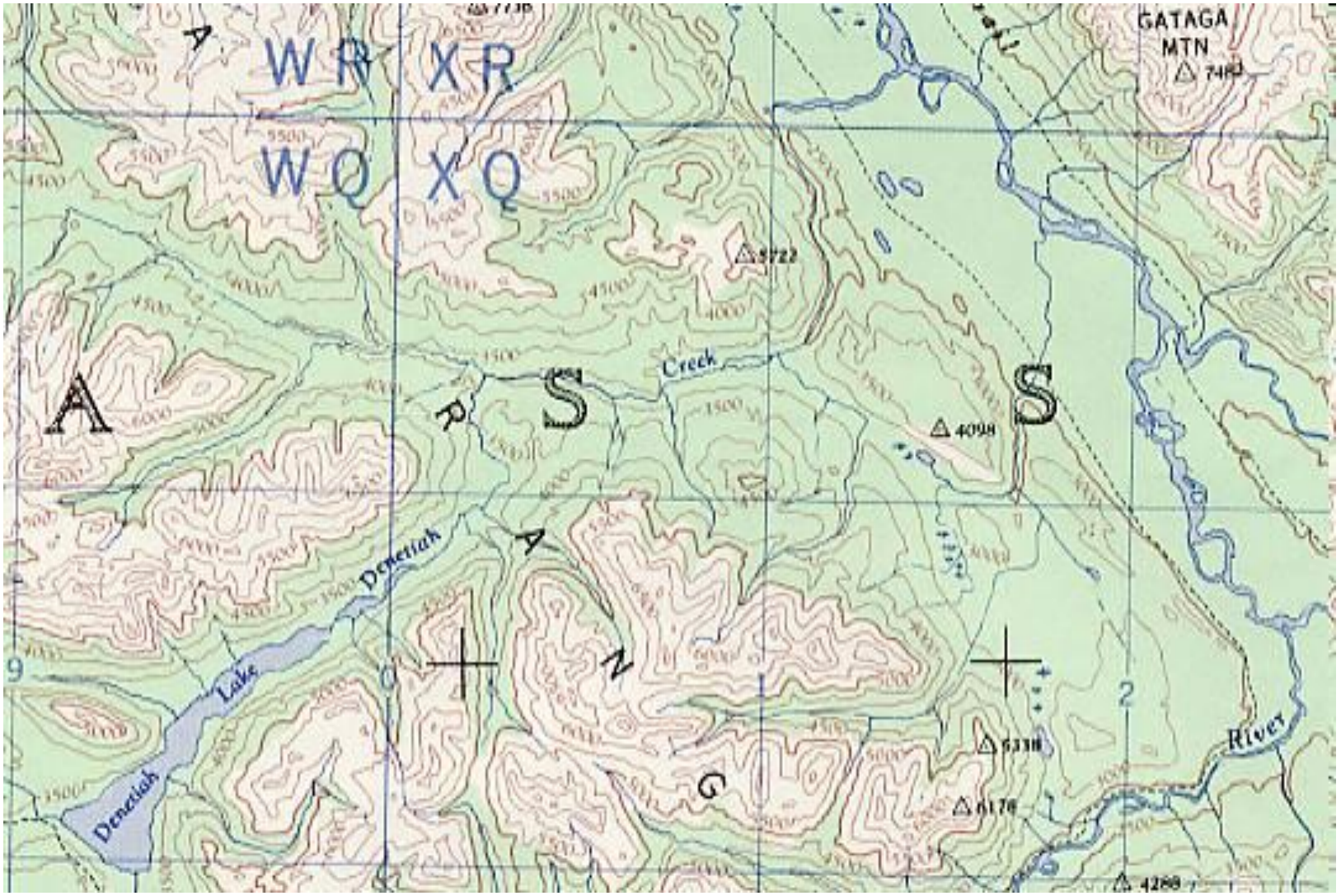
Mean Sea Level (M.S.L.)

Exploring Earth website - visualising contours

NTS Contour Intervals: - Normal, Hilly, Steep

1:50,000 = 10, or 20, or 40m ; 1:250,000: 50, or 100, or 200m

The main method for Canadian topographic maps at our two scales



Kechika 94L 1:250,000 -> Contour interval = 500 feet (pre-metric version)

Advantages of contours

- the most quantitative manual method
- effectively stores elevation heights
- needed for engineering, planning etc.
- the origin for other techniques
- familiar to many users (now)

1:50,000 Horseshoe Bay, BC

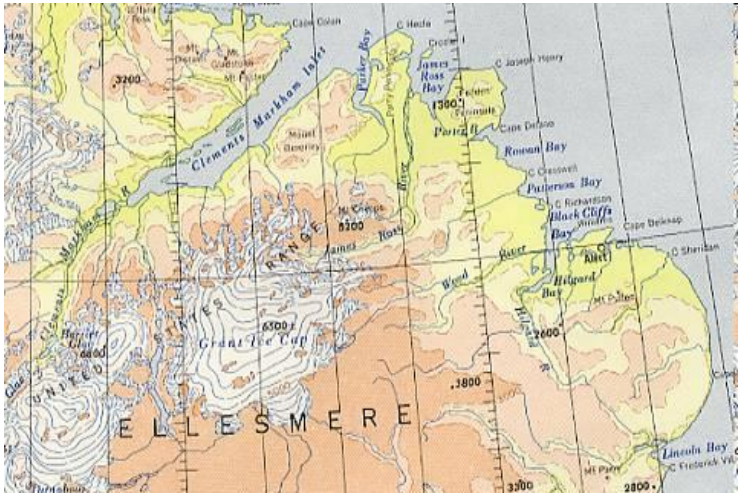
Disadvantages

- abstract - no lines on the ground
- less visual, depends on: contour interval, landscape, user experience.

These issues were recognized early on and led to other methods …

5. Hypsometric Tints

- The addition of colour to elevation ranges
- first tried as early as 1830
- a logical sequence, realistic colours
- the darkest still enables readable text

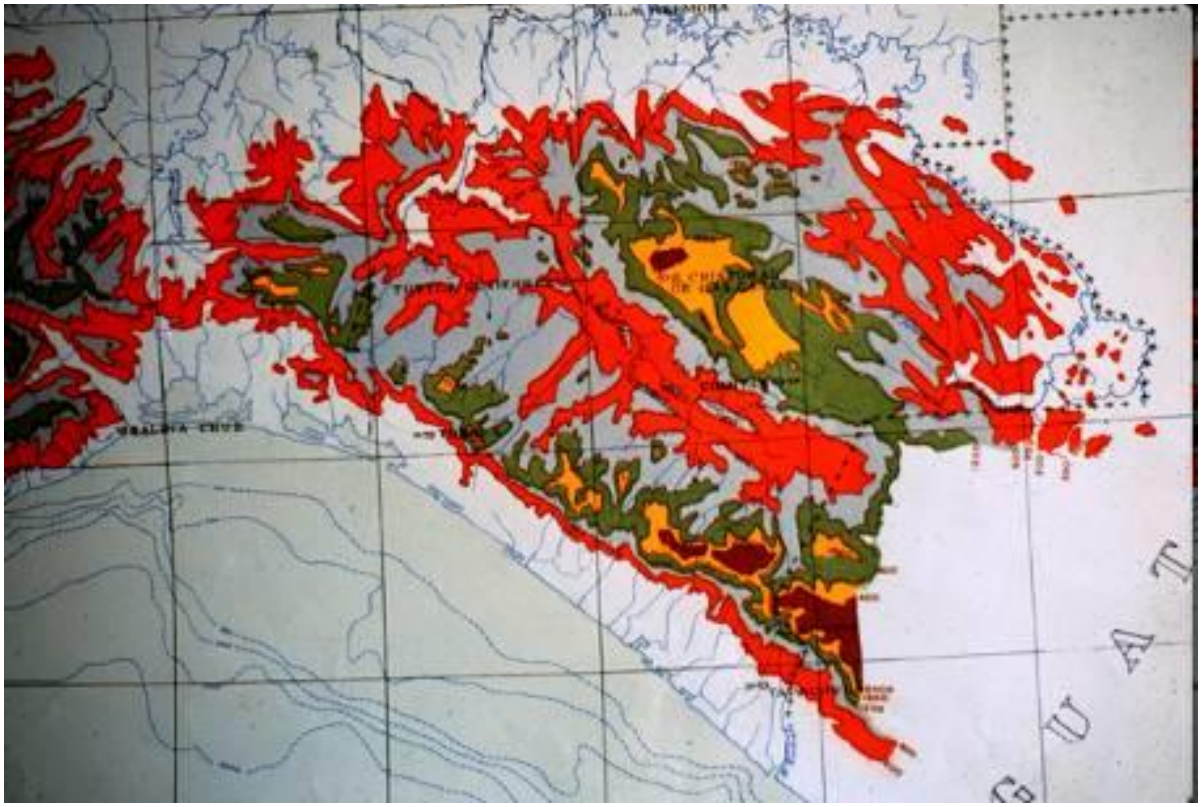


Advantage: adds visual impact at small scales; easily understood

Disadvantages

- exaggerated terrace effect, no new 'information' is added,
- differential contrast with other elements
- mixed color associations, (green with forest, etc.)

- which colour scheme?.. NOT the one below !



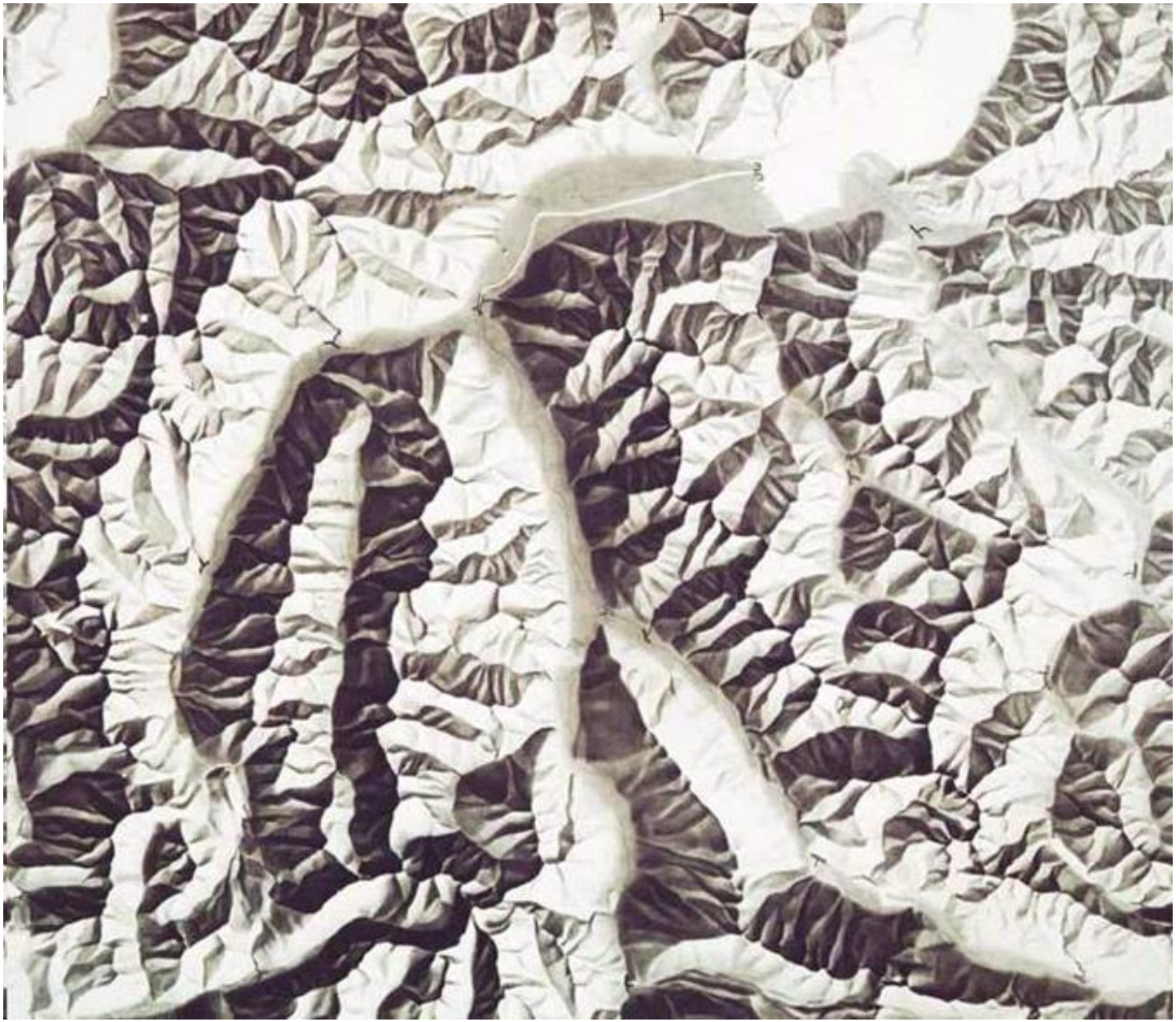
Two colour printing: Yoho

6. Shaded relief (hillshading)

The addition of shadows to give the illusion of depth, with a NorthWest light source (at ~45º elevation). – first introduced in the late 1800s

Why NW light ?

Where are the darkest and lightest shades ?

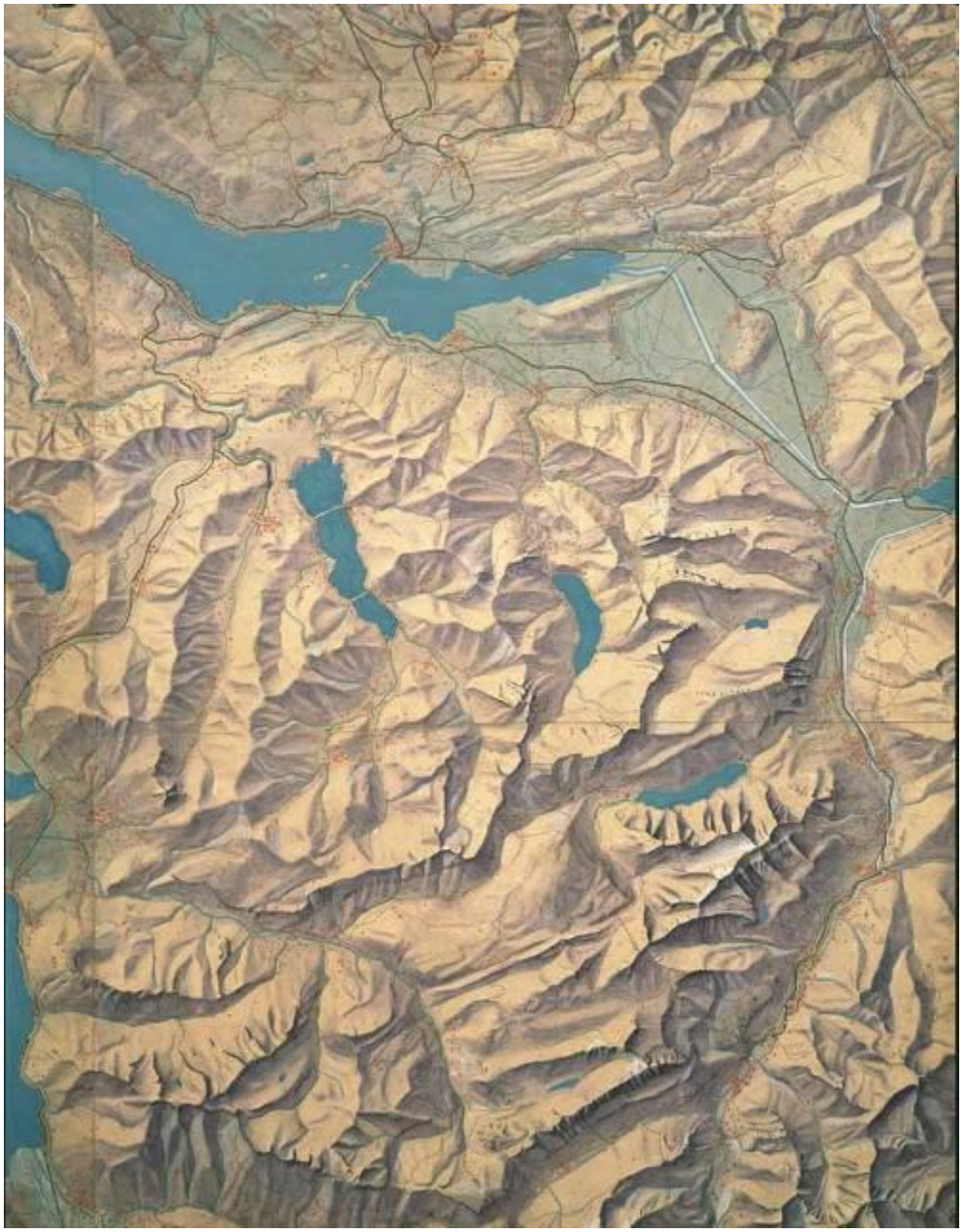


'pseudoscopic inversion'- with light from SE / bottom right

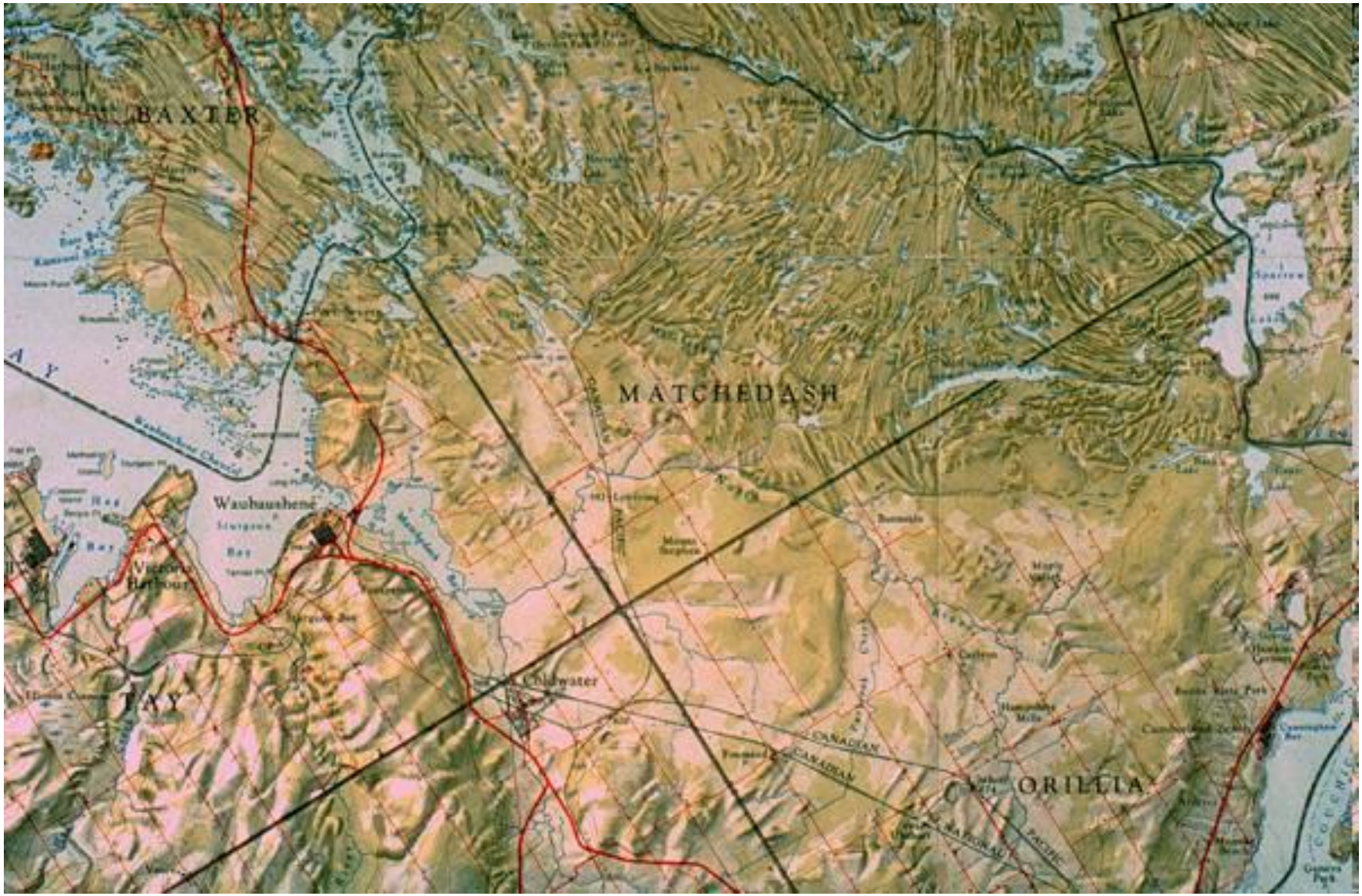
Eduard Imhof

Manual hillshading

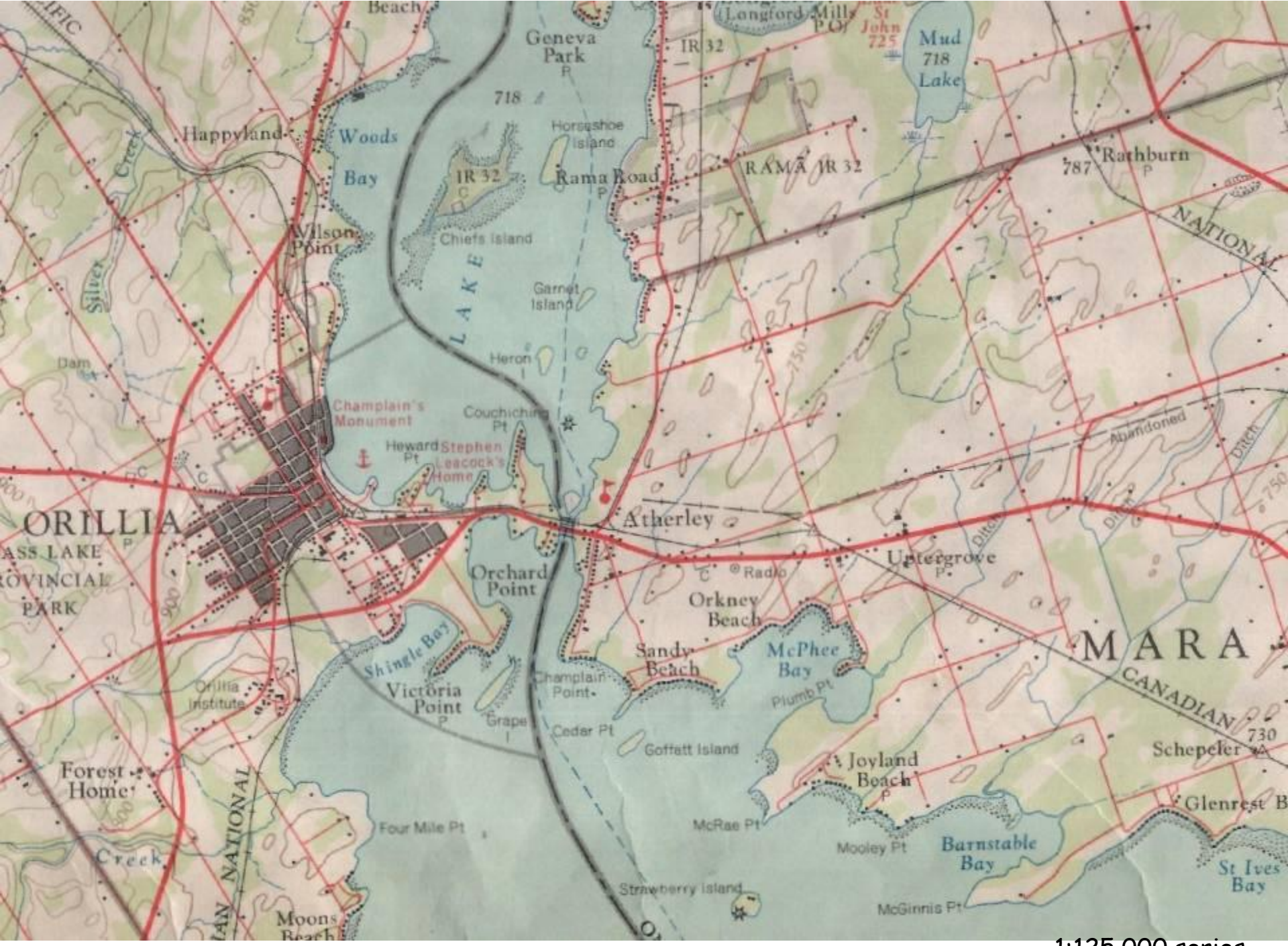
Eduard Imhof (1895-1986) was a professor of cartography at the Swiss Federal Institute of Technology Zurich 1925 - 1965. Produced with pencil or airbrush



Ontario, 1:125,000 ~1970 Manual shading (airbrush)



Swiss shading experts imported to teach Canadian cartographers
Shading enhances topographic features and acts as background for linework



1:125,000 series

with hillshading

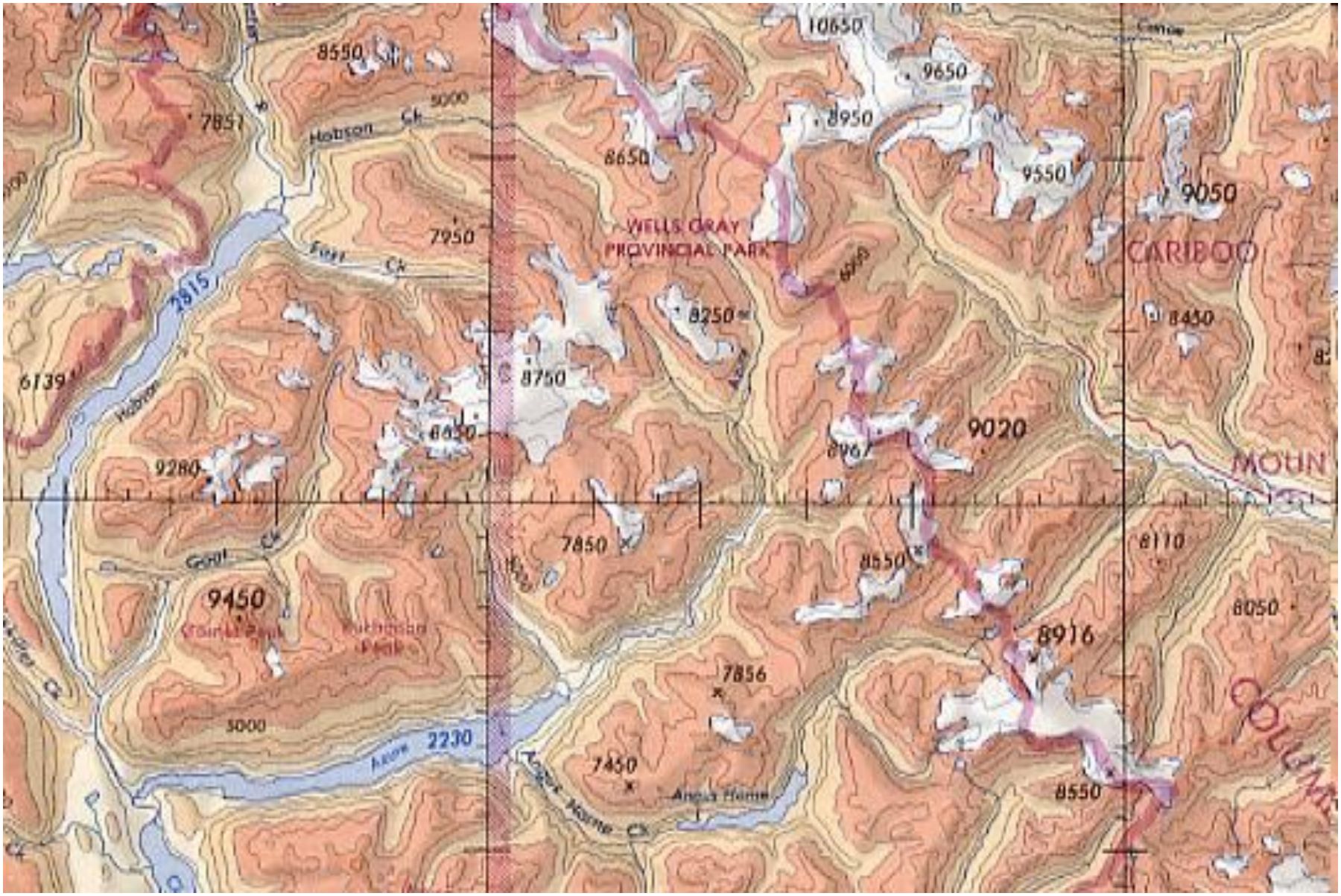
Advantages

- show detail / character of landscape
- highly visual, continuous appearance
- background for other map layers

Disadvantages

- required artistic creation with pencil or air brush
- costly (~100 hours / square foot) .. often poorly rendered
- some slopes can be too dark (SE slopes)
- no quantitative information for planners/engineers e.g. elevations

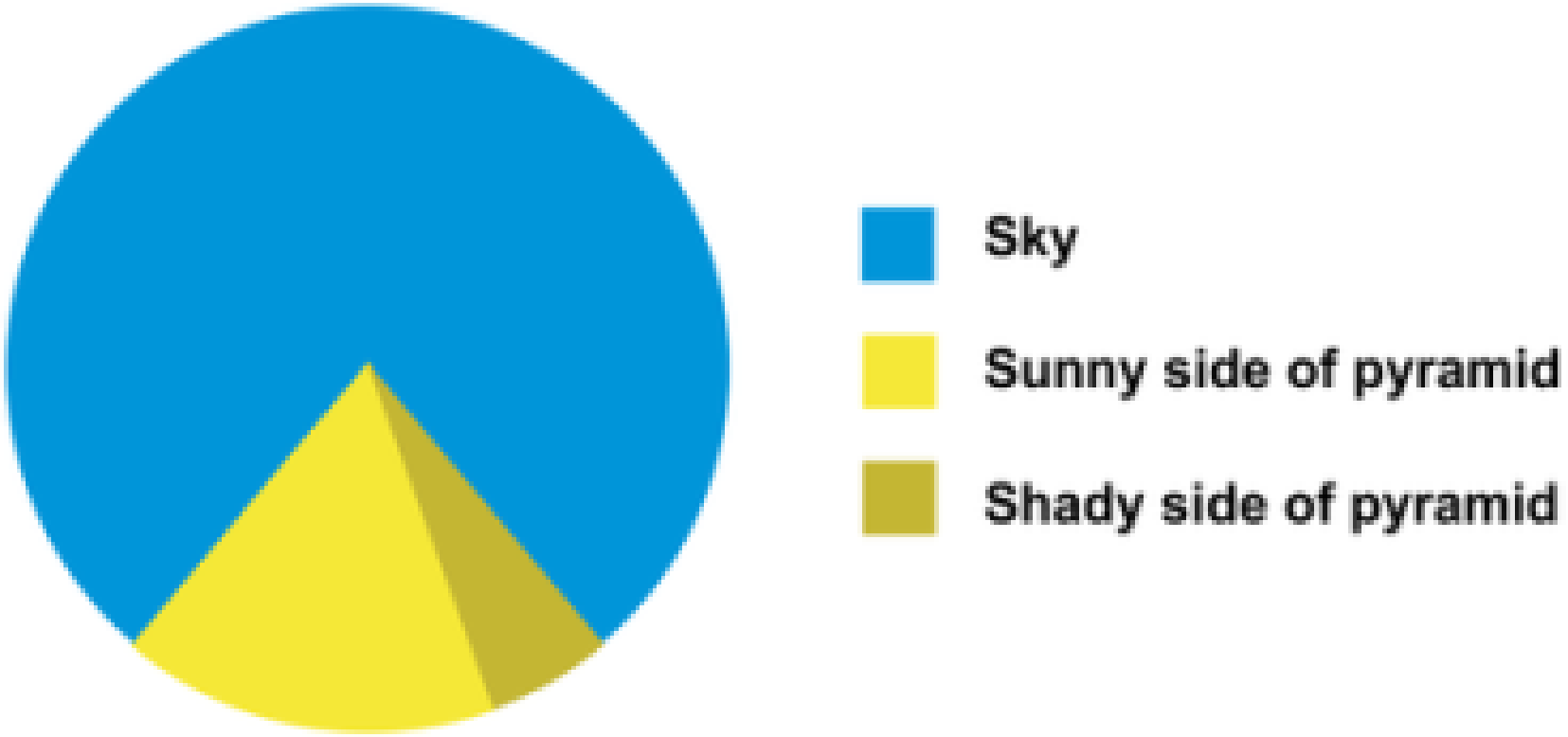
BC aeronautical map, 1:500,000 – contours, tints, shading and spot heights



All 4 methods needed for safe aviation – both visual and quantitative

Relief humour: ☺

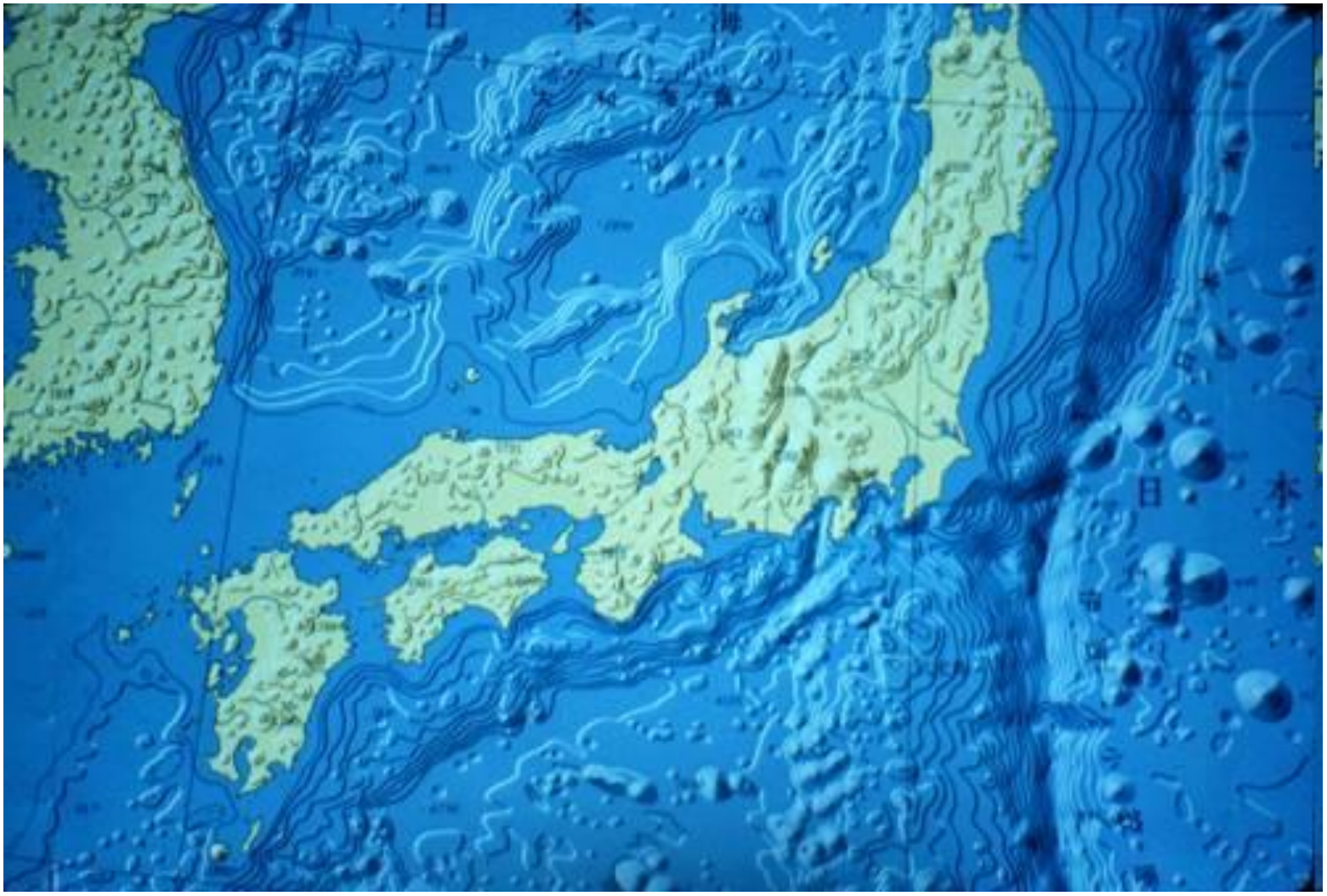
Pie chart for shaded relief / hillshading



7. Tanaka 'illuminated' contours

-pioneered in the 1950s by Kitiro Tanaka applying shading theory to contours.

-NW light source, white and black lines, variable width



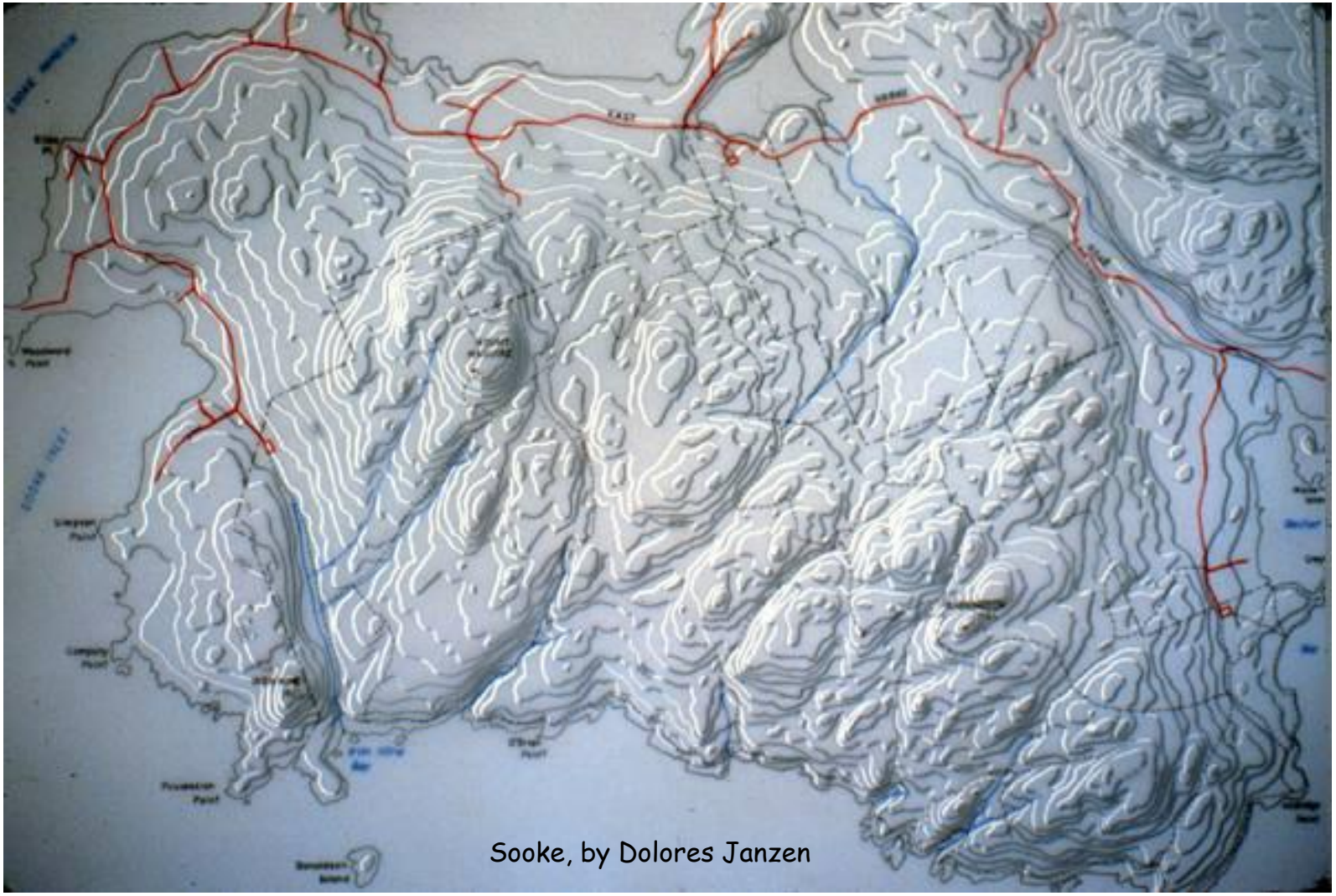
Tanaka contours are illuminated facing NW and dark facing SE, grading in thickness in between

Advantages

- visual and quantitative; unlike shading, it does not require artistic ability

Disadvantages

Requires a non-white background; visually exaggerates terracing



Sooke, by Dolores Janzen

8. Slope zones (example: Nose Hill Park, Calgary)

Not common before GIS, interpreted from contour maps - they show the importance of slope in affecting human land use
(similar to Cranbrook Hill)

9. perspectives (2.5D, not true 3D)

Advantage: the most visual portrayal of landscape / artistic

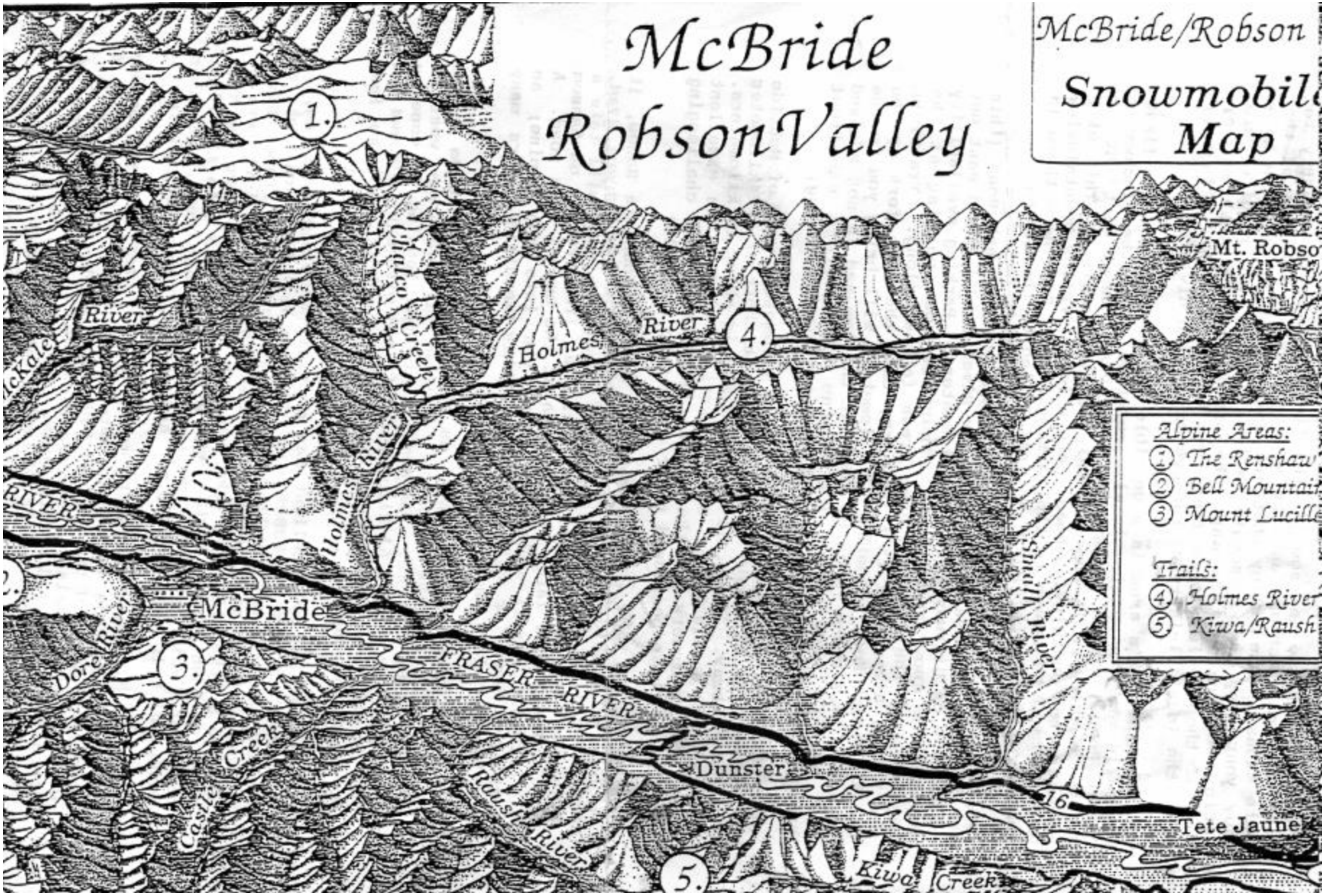
Disadvantages: time-consuming (pre-computers); no consistent scale

Canada example by Eckhard Ziegler

http://www.panorama-map.com

'Interesting' local example … sugar-loafs meet skidoos and hobbits

"Horses of McBride" 2008 (TV movie 2012)



10. 'true' 3D relief map (Plastic raised)

Truly 3D – takes up 3D space …

3D relief models (wood):

The world's largest map: Challenger map (1945-52) 25 x 25 m 1:50,000

Challenger map 'tile' displayed during 2010 Vancouver Winter Olympics for RCMP security operations. The map now sits in a warehouse stored in sections

https://bcsportshall.com/exhibit/challengermap

https://challengermap.ca

Summary of common relief depiction methods

TECHNIQUE	COMPONENT	FEATURES
Sugar loafs	shape	Simple, stylistic
Hachures	slope	much ink, no heights
Spot Heights	elevation	sporadic info
Contours	elevation	Heights, 'abstract '
Hyps. tints	elevation	Colour layers
Shaded relief	aspect	Visual, artistic
Tanaka	aspect	visual but 'noisy'
Slope maps	slope	uniform slope areas
2.5D perspectives	shape	visual, no fixed scale
Physical models	all	true 3D – takes up space