The Isoline

or the Rise and Fall of the Statistical Landscape

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Isolines are curves along which a continuous field has a constant value: they show connections between two places that share a common value.

While working as surveyor for the city of Rotterdam at the end of the 17th century, Pierre Ancellin produced a series of maps of the river Meuse that showed a geographical feature never seen before: the surface of the riverbed represented through bathymetric lines at intervals of 5 by 5 feet. The map was meant to guide navigation along the shallow waters of the Meuse, but, most importantly, to be a visual aid for the design of dams and other infrastructure that would prevent the expanding port of Rotterdam to silt up with sediments. The hidden topography below the river's surface and the indeterminate turbulence of water flows were made visible to the eye of the planner through numbers turned into lines.

A few years later (in 1701), a more famous example of this newly invented graphic tool appeared in Edmond Halley's isogonic chart of the Atlantic Ocean, where continuous lines stretched across the sea to show the irregular variations of the earth's magnetic field. Anomalies in the behaviour of a ship's compass could be removed to the benefit of a safer and faster global maritime trade. In just a few years, the isoline—an artifice to visualise invisible phenomena in relation to their statistical distribution—bridged the gap between the local scale of the city and the global one of the planet.

A century later, Alexander von Humboldt popularized it through his map of isothermal lines: the very first representation of the global climate. By the early 20th century, a list of more than 90 isolines—mostly related to meteorology, but also portraying the distribution of social, economical and political dynamics—were defined in scientific literature, and made their way to the general public by appearing on widely distributed atlases, the front page of newspapers, and, later, on TV. This growing family, composed by numerous constituent of the same gene (the isotherm, isobar, isohyet, isohaline, isohume, isoneph, isohel, isotac, just to name a few), constructed a new planetary imaginary harnessed by numbers. A vast observation network scattered across the globe fed the isoline with data: astronomical observatories, lighthouses, buoys, radiosonde, ships, automated weather stations sensed the environment and communicated via a network of electrical and, later, digital signals. The uneven and necessarily limited occurrence of these sensors was ideally augmented by the isoline: by creating the illusion of a continuously measured surface, it made this sensing network virtually ubiquitous.

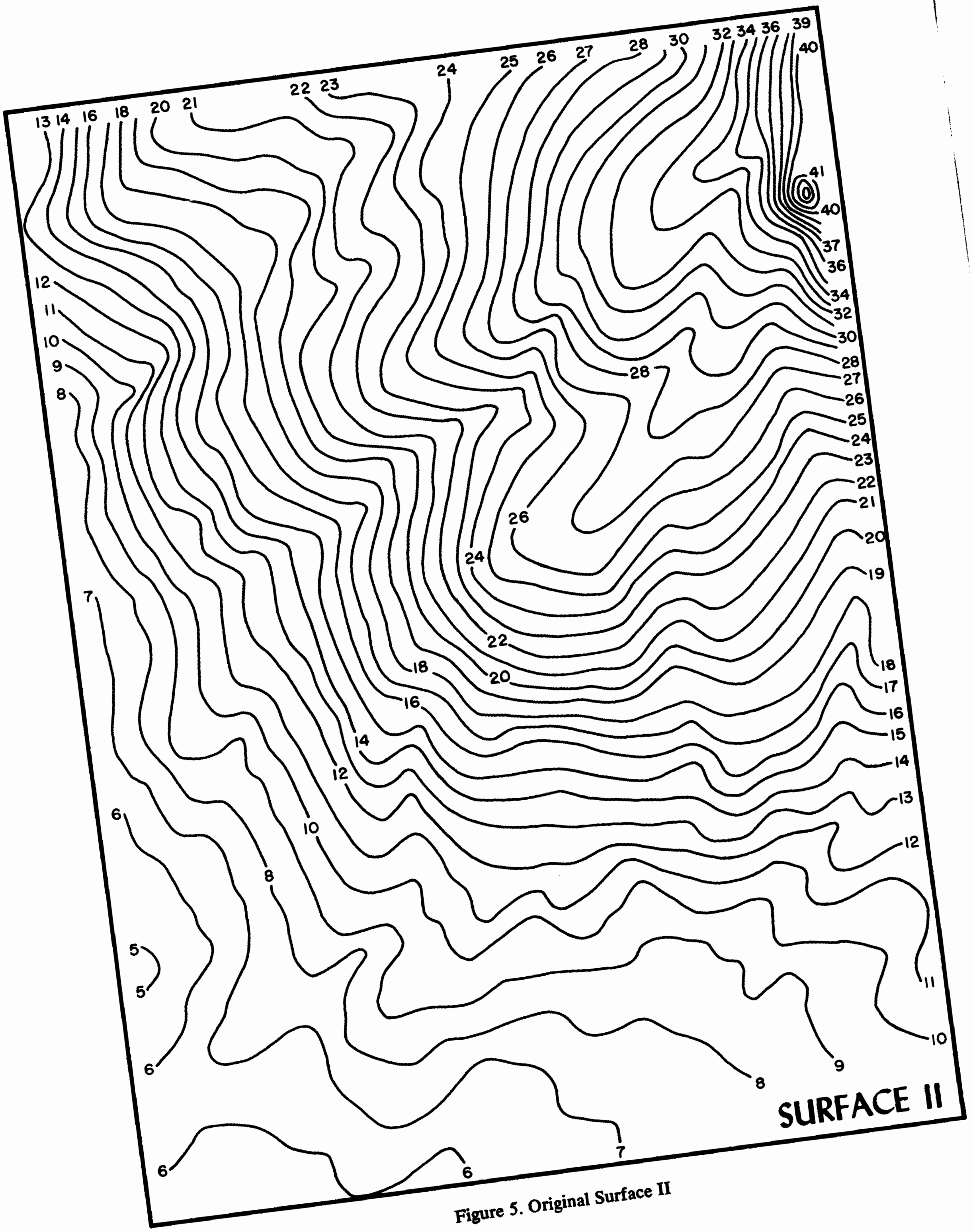

Figure 5. Original Surface II

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These isometric surfaces rendered the natural world into normalised pictures that could be almost instantly translated into governmental and personal decisions—from the allocation of agricultural subsidies, to the planning of suburbs, to the route towards a holiday destination. The isoline was factored into environmental policies, urban planning, architectural design, and the very fabric of people's lives. It progressively became the predominant tool that would reveal the relationships between apparently disconnected realities, both to make sense of the environment, and to make it exploitable. If contemporary weather prediction models and nearly real-time visualizations have replaced the discrete vectors of many of their scientific applications (thanks to the granular view of the remote sensing apparatus), isolines are still widely used in everyday communication. The poorly understood logic of their discrete thresholds still fails to represent the huge complexity of the current climate, thus affecting our perception of the environment and the problems we face. The two degrees warming limit posed as a goal for the strategies to reduce global emissions is just another example of this approach, where almost meaningless average numbers are used to depict much more ambiguous dynamics. This "brevity of a number" collapses in front of the complexities of how global warming will unfold across different regions of the planet.

In an era when geopolitics are being shaped by the unpredictability of ecological processes, we need to find a new visual language to communicate our world. The means of architectural representation can play a fundamental role to frame continental-scale territorial transformations and challenges as the ultimate tool to determine global politics.

The studio will start by exploring the concept of the isoline, both from a historical, cultural and mathematical perspective. We'll chart how the statistical view of nature and ecology has risen over the past centuries, and has been used as a predominant blueprint for mapping, planning and the management of space, societies and the environment. We'll outline the different isoline systems through their epistemologies, the language through which they have been crafted, and their methods of calculation—and then focus on a specific geographic perimeter, in order to investigate how isometric surfaces have been at play across the North American landscape. Isolines can be temporary or permanent, and their different geometries produce an infinite variety of spatialities across the territory. The analysis of a series of case studies will allow us to look at the multiple other geographical fictions that the isoline produced during its long history, in an attempt to trace a genealogy of the quantified environment. We will collect multidimensional portraits of the landscapes (through films, photography, accounts of indigenous knowledge and other media), in order to debunk and decolonise the Western cartographic gaze that up until now has ruled our approach to land-use mapping and planning. If isolines represent fields of equal values, how can we define alternative equalities? What other metrics can we think about? What is the relationship between the sensing and mapping of a territory and the claims upon it?

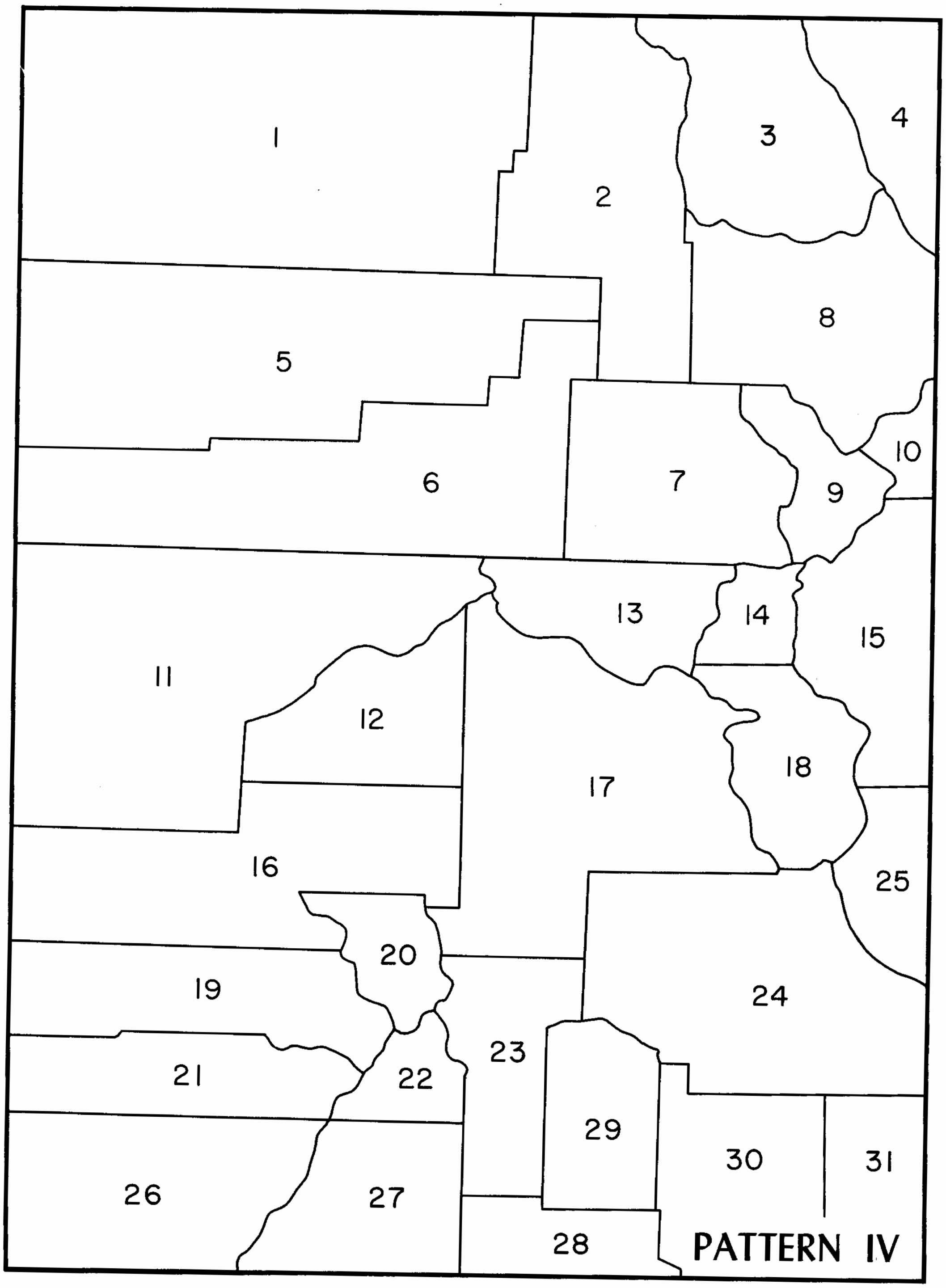

Figure 11. Unit Area Pattern IV

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OUTPUTS

The studio's outputs will include a variety of visual props that will help us trace the history of the isoline as a spatial planning device: from a new, collective atlas of the North American landscape that will contest the very idea of the isoline and its assumptions, to speculative tools and instruments of surveying; cartographic models and assemblages that propose a different way to interpret the landscape; prototypes that could simulate different isolines in "laboratory conditions"; architecture proposals to reveal the isoline in the landscape, both in the form of territorial-scale physical visualisations and devices to transform the isoline into a sensible experience. If the isoline is an active agent in the transformation of the environment, how can make it manifest beyond the map?

METHODOLOGY

We'll effectively work as a collective design and research studio, sharing documentation, insights, and feedback between groups. Since our object of inquiry is one that needs to be unpacked through space and time, the output of the studio will excavate different case studies in order to trace a genealogy of the quantified environment. Each group will choose one particular type of isoline; draw the history of its concept, measurement and representation; detail the tools, systems, architectures that have been used for its representation; chart alternative histories along the way; scour its traces in the past and present conditions of the built environment. All of the design outputs will have to be highly detailed, while at the same time keeping a highly speculative approach to the understanding of two centuries of human intervention on the landscape. Representation and visualisation will be used eminently as research tools to organise and communicate information. The aesthetics of the studio will be modelled through the study of contemporary artistic and design practices that have been working on similar issues, and also by dialogues and conversations with anthropologists, climate scientists, historians of science, GIS practitioners and other guests that will be regularly invited for talks.

FIELD TRIPS

Two short trips are in programme during the first weeks of the studio: in the first one we will visit the American Museum of Natural History in New York, as a way to explore the way in which the natural environment has been crystallised in a museum-form. In the second one (TBC) we will travel to College Park, MD, to visit NOAA's Center for Climate Prediction.

CALENDAR

WEEK 1	Understanding of the concept of the isoline and its historical implications Assignment of isoline types Research of case studies through the North American landscape
WEEK 2	Identification of the problem and the environment to survey History of the methods of surveying of that particular ecology Contact people and experts in the field First trip: American Museum of Natural History
WEEK 3	The problem of interpolation Design tools for surveying Second trip (TBC): NOAA Climate Prediction Center, College Park, MD
WEEK 4	Aesthetics and politics of tools Imagine a spatial intervention as a speculative approach to counteract the isoline device Preparation for mid-term
WEEK 5	Mid-term reviews
WEEK 6	Cartographic models and assemblages Definition of the spatial intervention
WEEK 7	Design reviews
WEEK 8	Design reviews
WEEK 9	Final crits and celebration

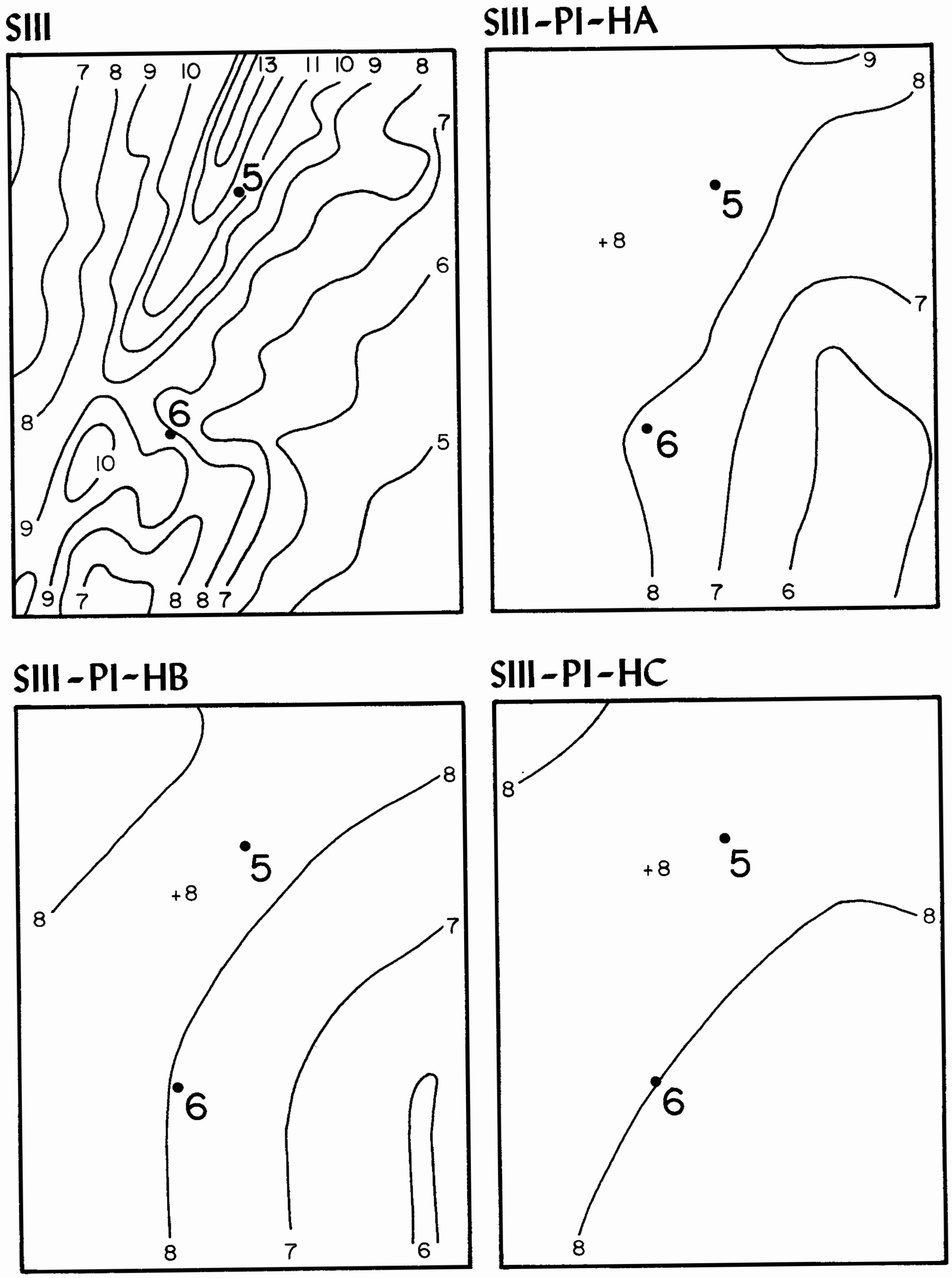

Figure 16. Effects of the Chance Locations of Sample Points on Magnitudes of *D* Values in Relation to Generalized Average Values. Illustrated here are the lower left corner of Surface III and three of the resultant isopleth maps showing sample points 5 and 6.

CORE BIBLIOGRAPHY

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Additional readings and references will be shared on weekly intervals, on the basis on the studio's progress and the topics discussed during classes.

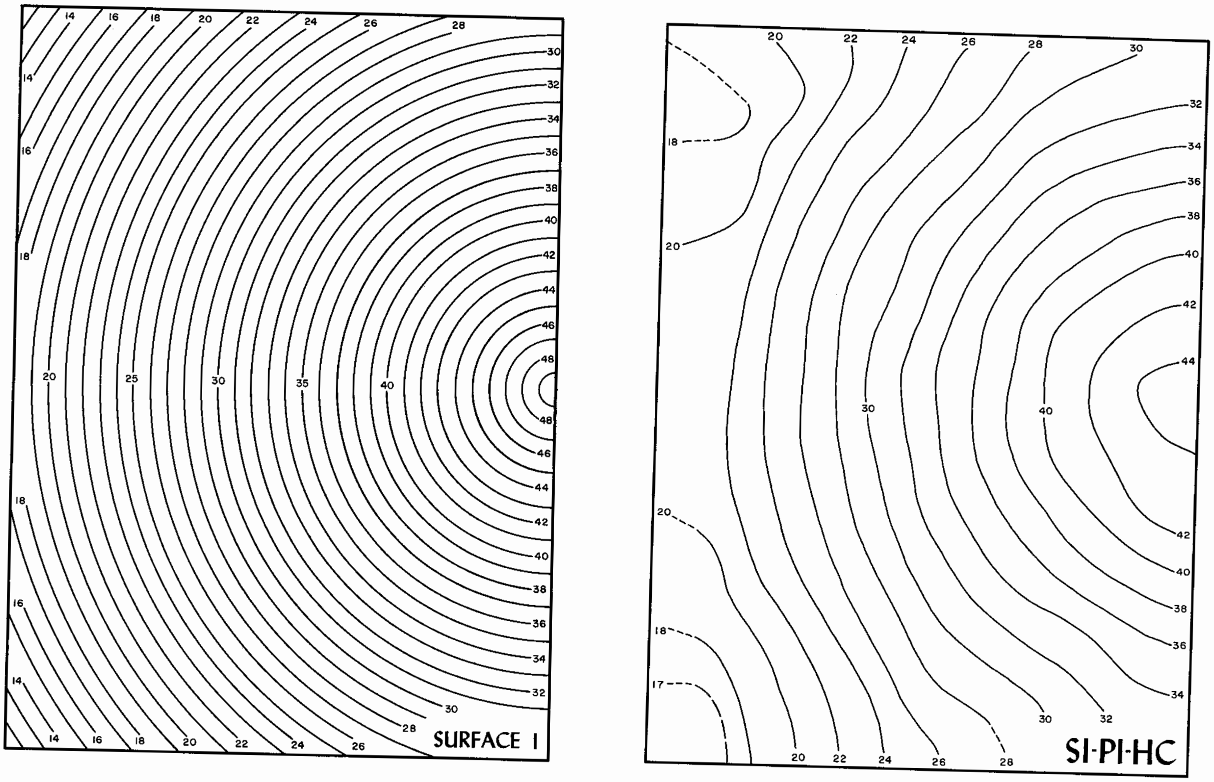


Figure 22. Surface I and Its "Best" Isopleth Representation, SI-PI-HC

For a given level of generalization, it is abundantly clear that only certain amounts of the surface variations and basic features of a distribution can be preserved on isopleth maps.

In terms of the complex of spatial character judged visually, the following isopleth maps seem to provide the best reproductions of each of the original surfaces: SI-PI-HC, SII-PI-HB, SIII-PI-HA and SIV-PI-HA (Figures 22 to 25). These maps probably represent the best that can be done, quantitatively and qualitatively, within the restrictions imposed by the prescribed mapping procedure. A comparison of these maps shows clearly that the most complex distribution suffers the greatest loss. Thus, at a given level of generalization and with a given mapping procedure, the fidelity of an isopleth map derived from a complex surface configuration is likely to be very much lower than that of one derived from a simple surface.

As for Surface I (the simplest distribution), with the exception of maps of SI-PIV all the isopleth maps retain its basic characteristics – namely, a unimodal surface with the peak at the central right margin. The only distinctive but minor departure from the original surface is found at the upper and lower left corners of the maps, where a small number of isopleths tend to curve to the left rather than to the right as do the rest of the isopleths. This is presumably due to the fact that there are fewer control points at the marginal areas and the locations of the isopleths are less certain. Comparatively, the five maps of SI-PIV represent the original distribution rather poorly. The locations of the isopleths on the left halves of the maps are adversely affected by the unit area pattern, as was discussed previously; thus they misrepresent the surface. The remaining parts of the maps, however, retain the basic features of Surface I.

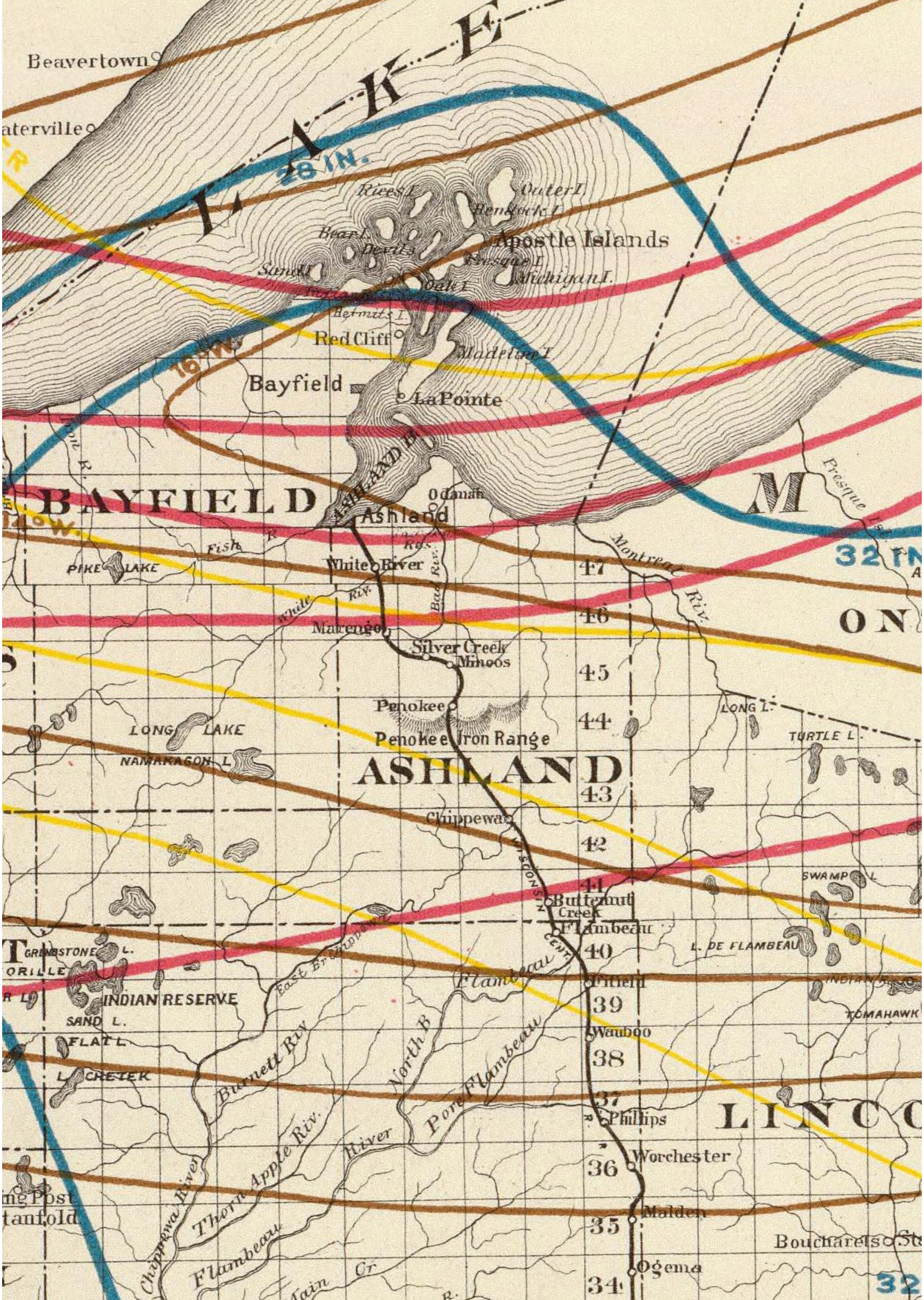
Similar comments can be made for maps based upon Surface II with, probably, one reservation: the basic characteristics of the distribution tend to fade away on

REFERENCES

Marco Ferrari is an architect, designer and co-founder of Studio Folder, an agency for visual and spatial research based in Milan, Italy. His main research interests focus on the relationship between visual representation, cartography, and the politics of territory. He completed a graduate degree in architecture at the IUAV University of Venice and holds an MA in History and Theory from the Architectural Association in London. As founder and partner of Salottobuono, a former research and design collective based in Venice, he authored *Manual of Decolonization*, a book published within the research framework of Decolonizing Architecture. From 2011 to 2013 he was the creative director of *Domus* magazine, and has been a regular graphics editor for *Abitare* magazine between 2007 and 2011. He has been teaching Methods and Tools for Representation at ISIA Urbino since 2010, and led an Information Design laboratory at IUAV University in Venice between 2013 and 2016.

Studio Folder develops projects working both with cultural institutions and commercial clients, working across the the editorial, digital and spatial domains. The studio is actively engaged in the investigation of autonomous research paths through the production of speculative digital platforms and interactive installations. Together with Andrea Bagnato, the studio authored *A Moving Border. Alpine Cartographies of Climate Change*, a book based on the long-term project Italian Limes, jointly published by Columbia Books on Architecture and the City and ZKM Karlsruhe in 2019.

www.studiofolder.it



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Outer I.
Apostle Islands
Bear I.
Devils
Sand I.
Oak I.
Michigan I.
Red Cliff
Madeline I.
16°W.
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La Pointe
BAYFIELD
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Ashland
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Fish R.
PIKE LAKE
White River
White Riv.
Bad Riv.
Montreal Riv.
Presque Isle
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Marengo
Silver Creek
Minoos
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Penokee
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Penokee Iron Range
LONG LAKE
NAMAKAGON L.
LONG L.
TURTLE L.
ASHLAND
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Chippewa
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Wisconsin Cent.
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Butternut Creek
SWAMP L.
Flambeau
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L. DE FLAMBEAU
GRINDSTONE L.
INDIAN RESERVE
SAND L.
FLAT L.
East Br. Chippewa
Flambeau
Fifield
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Wauboo
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Burnett Riv.
North B.
Pore Flambeau
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Phillips
LINC
Thorn Apple Riv.
River
Chippewa River
Worchester
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Malden
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Flambeau
Ogema
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Bouchards
TOMAHAWK
INDIAN
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