A CURRICULUM ON THE FABRICATION OF CLOUDS

by

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Bachelor of Architecture
Rhode Island School of Design, 2015

Bachelor of Fine Arts
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ABSTRACT

To draw clouds is inherently a paradoxical act; yet artists and scientists have drawn skies for millennia, setting themselves up for failure as soon as they made a solid mark. Cloud depiction is an extreme case in representational systems – drawn schemas for cloud depiction are simultaneously tools for experiments and experimental drawings.

As writer Marcel Beyer states aptly, 'if you devote yourself to clouds and their study, you're lost,' unless 'one changes perspective and regards nephology itself as the laboratory - as one of the 19th century's great laboratories of poetic and artistic theory.' Nephology, the science of clouds and its visual methodologies, is a model for designing exact measures for inexact subjects.

Representation, a fundamental topic across many disciplines, is an invaluable contemporary educational medium. *A Curriculum on the Fabrication of Clouds* is a collection of drawing experiments framed as pedagogical acts. It consists of three lectures on the drawing theories of Masanao Abe, Alexander Cozens and John Constable, to be performed; a series of computational drawings addressing analogicity and digitality; a workbook documenting methodology, and an architectural move. *A Curriculum* is a demonstrative case for drawing as research, and a view into designer-experimenters who research through drawing (and inevitably, research drawing).

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dedicated
to that
most capricious
never – to – be – understood
weathercocky
provokingly incorruptible
and
absolutely necessary person
the gentle reader[1]

[1] Tuer, Andrew White. *The book of delightful and strange designs; being one hundred facsimile illustrations of the art of the Japanese stencil-cutter, to which the gentle reader is introduced,* 1893.

Index as Preface

> "What kind of thing is a cloud?"
> – Sadie Plant, *Something in the Air.*

This is a body of research on drawing clouds. It examines theories of drawing as produced by artists and scientists for insight into visual methods in research and experimentation. Cloud drawing is the common ground on which methodological concerns in representation may be addressed at the intersection of multiple areas of study, specifically between the means of image production in science and representational methods in design.

Analogicity

> The activity of cloud depiction and the produced image are both well suited as analogies for the discretization of continuous forms. It is the process of which an image of cloud is translated into a drawing of cloud that is instrumental in establishing a design schema. Any extreme case of a representational system is a valuable subject of study – rules break and horizons fade, an inflexion point is where principles can emerge from errors.

Cloud

> Cloud in contemporary discourse is rarely a cloud. Cloud is so frequently cited as a model of coherence in design, that it has become the trope shape of the 21st century. Cloud is a topological trap, a vortex for indescribable shapes. Any thing that is comprised of many parts can claim to be Cloud: network infrastructure, a quantified self, a murmuration… The cooption of the term cloud is symptomatic of a state of being. Whether it is a philosophical contemplation of uncertainty or a manual on the creation of artificial clouds in the atmosphere, one is sent off on a mess of trajectories when provided with the image of cloud. Before clouds disintegrated into a symbol for ultimate heterogeneity and dynamical systems, it too had a body with shadows and outlines. As a physical phenomenon, clouds are visible clusters of aerosols and water molecules that exist in various layers of our atmosphere. Their amorphous nature has long escaped conventional scientific protocols for the production of knowledge: clouds have no specimen, no archive, no artifacts; up until contemporary developments in atmospheric science, there was nothing for the scientists to bring back to the laboratory. This produced a situation where scientists either gathered information externally, or simulated conditions to interpret cloud phenomenon. These interpretations are directly related to their technologies at hand, whether it is drawing, photography, memory or poetry. As a diligent and aware observer in the world, I am sure you have a cloud reference to share with me. A website has been made to satisfy this desire: www.knowthiscloud.com.

Curriculum

Representation, a fundamental topic across many disciplines, is an invaluable contemporary educational medium. A curriculum is comprised of a series of methods by which objectives are determined. A curriculum is a race, a course of study, a set of goals and objectives for mastering certain ideas or skills. Propositions for polyphonic models of learning have traditionally occurred on the fringe of institutions, as "extra-mural." Recent decades, *educating the masses* took hold of our everyday life. *A Curriculum on the Fabrication of Clouds* is structured as a series of pedagogical acts, paying homage to the rich record of learning models produced in the disciplines of art and design. *A Curriculum* acknowledges that design education is a unique model within general educational frameworks, and that design research, in addition to the advancement of theory and design methodologies, is also responsible for cultivating pedagogical models and prototypes for design education. Cultural institutions have tended towards education, as demonstrated by the surge in curation, exhibition and archival activities as alternative spaces of learning.[1] In 1963, George Nelson and Charles Eames conducted a pedagogical experiment in the Department of Fine Art at the University of Georgia, titled "A Rough Sketch for a Sample Lesson for a Hypothetical Course", in which they proposed methods for communicating course material to students in a "decompartmentalized" way.[2] They designed an immersive space for learning that integrates references and visuals across disciplines relying on various novel applications of media to deliver the information. This method is modeled as a dialectical approach. Aby Warburg famously described his *Bibliothek* as a *Denkraum*, a "thinking space" in which contents are arranged in temporary "alliances of attraction."[3] A thinking space is where various models of thinking are *enacted*. Similar to Warburg's library, "A Rough Sketch" allowed for knowledge montage, where discrete artifacts from different areas of study are arranged based on intuitive associations translated spatially and temporally onto physical relations.[4] The masses, as students, are brought in contact with the constellation of artifacts that are otherwise stuck in design spaces without atmosphere and friction. *A Curriculum* provides a series of lectures that are to be performed and consumed in no particular order. The goal is to introduce an improvisational structure to knowing, to rely on context and atmosphere to animate its contents.

Orthography of Nebulous Forms is to be performed by one individual.
Lecture One: *Observation, a decomposing of sky* is to be performed between two individuals.
Lecture Two: *Algorithms, appropriation* is to be performed by one individual.
Lecture Three: *Systems, resolving depth* is to be performed by one individual.

Digitality

In addition to drawing, designers produce specific types of representations, such as technical and digital images. However, drawing, representation and images are three distinct categories with corresponding lineages and process that should not be conflated. The virtualization of fundamental elements such as point, line, raster and edge in different tools become instrumental in determining what an image is. Any exercise in determining criteria for a digital image involves the evaluation of a space - time relationship between parts and whole. Whether it is a point enabled by time to produce a line, or the addressability of pixels within a grid, the basis for a digital image is

centered on the temporal sequencing of information within material limitations of technology. In terms of a computer image, time is a medium through which an image emerges from digitalization processes and approaches reality. Digital images are artifacts revealing how tools deal with time, and in turn, how tools affect the readability, fallibility and the capacity for an image to deceive in real time. Tool is to digitality what the style of linear perspective is to vision: tools are means to enable a structure for digitality, which exists in an environment otherwise invisible to a visual regime. A digital image is produced through a combination of tooling and temporal sequencing of matter.

Drawing

"Drawing, it seems, is here neither representation nor remembrance, but fabrication and invention."[5] Drawing is an activity with ambiguous implications across different disciplines. Any effort to pin down a universal understanding of drawing, as both process and product, has been no small feat.[6] A common issue that plagues productive studies of drawing is the lack of contextual information to relate drawing methods to concerns of how drawings work in design studies. Patrick Maynard, philosopher of 'all kinds of drawings,' outlined in *Drawing Distinctions* the two modern technological questions that pertain to drawing: one, the extent to which drawings are used in making new kinds of things, and two, new kinds of drawings.[7] Design studies are concerned with the first category, the ways in which drawing participates in allowing various tools to produce designs. In this case, drawings are functioning in service to tools and methods. Drawing, is not an autonomous practice, and relies on technologies of production to fulfill a function. Sometimes, drawings may be created solely for the purpose of communicating between tools – the value of its existence is in its value for production. The category "new kinds of drawings" in design discourse has been almost synonymous to new kinds of tools – an assumption that new tooling ontologies will naturally result in new ways to draw. This is only partially true. While advancements in devices do introduce novel ways to draw, the resultant drawn artifact does not always establish a new species of drawing. New kinds of drawings entail forming new kinds of drawing elements and organizations, novel techniques that elicit qualities of representation distinct from existing moves. The drawings produced in this work are considered working objects. A working object is a communal representation of a sector of nature under investigation, used to standardize scientific objects of inquiry.[8] Drawing *as* art is a tendency. Deanna Petherbridge considers drawing as "autonomous practice," in which only the "authorial artist" can define drawing in its liminal state.[9] Since no drawing practice is deprived of a space and a context, the acknowledgement of the process is crucial for it functioning as a drawing. This is not an argument for "make drawing a drawing again" or a return to nostalgic practices. Even for Leonardo da Vinci, *homo pictor* and *homo faber* have already become dialectically intertwined: picturing and making constitute the fabrication of effects.[10] Da Vinci's exploratory drawings were considered an emblem of transition from a Platonic tradition of drawing for mimesis to "drawing as instrument of thinking and as an essential activity in research and invention."

Incursive method

An incursion is an invasion or an attack usually into a place or a territory, a momentarily taking over of, a raid. Juxtaposition, disjunction, estrangement...are all methods through

which artists, designers and theorists alike have deployed to gain 'new' content from existing forms. An incursive method is interplay between organizational systems and improvisational acts, a cooption of an existing norm to produce other effects. It is research done laterally, working in knots. Svetlana Boym coined the term "off-modern" as a "non-linear conception of cultural evolution."[11] This cooption of a feature, when a trait evolves to serve one particular function and subsequently serves another, is also known as "exaptation" in biology. "In this context of conflicting and intertwined pluralities, the prefix 'post' is passé." Post-, anti-, neo-, trans-, sub-, inter-...an inability to escape an illusion of linear progress plagues design studies and hinders the development of critical methods.

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[1] Examples of exhibitions that have taken on pedagogical motivations include, *A Curriculum* at HKW, *SALTWATER: a Theory of Thought Forms* and *Radical Pedagogies*.
[2] http://www.eamesoffice.com/the-work/sample-lesson-for-a-hypothetical-course/
[3] Vesters, "A Thought Never Unfolds in One Straight Line: On the Exhibition as Thinking Space and its Sociopolitical Agency." Stedelijk Studies.
[4] Ibid.
[5] De Warren, "Ad Infinitum: Boredom and the Play of Imagination." *Infinite Possibilities*. 2004.
[6] *Writing on Drawing*. 2012.
[7] Maynard, *Drawing Distinctions*. 2005.
[8] Daston and Galison, *Objectivity*, 19.
[9] Petherbridge, "Nailing the Liminal: The Difficulties of Defining Drawing." *Writing on Drawing*, 2012.
[10] *Writing on Drawing*. 2012.
[11] Boym, *The Off-Modern Manifesto*. 2010.

Orthography of Nebulous Forms: Drawing, Rules for Drawing and Drawing Poorly in Early Cloud Studies

"When it comes to clouds, every object-description is a self-description."[1]

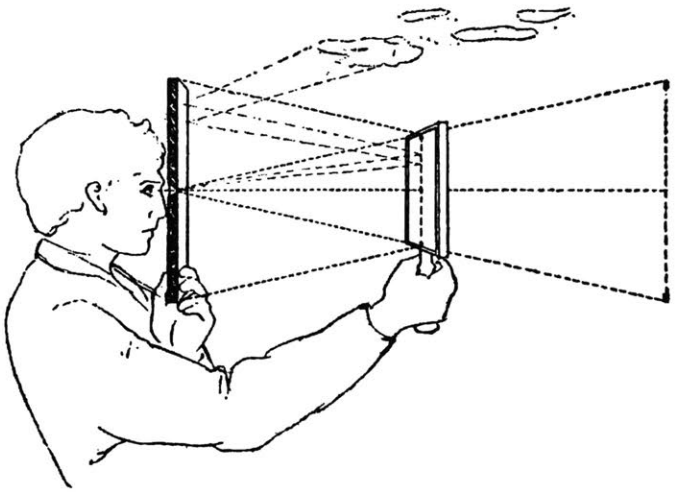

Figure 1: A reconstruction of Brunelleschi's first perspectival experiment. Alessandro Parronchi, *La dolce prospettiva.*

The dive into clouds begins with a demonstration mistaken for an experiment. Filippo Brunelleschi is rumored to have painted on a small square panel the perspective view of the Baptistery of San Giovanni in Florence as viewed from inside the central doorway of the Cathedral of Santa Maria del Fiore.[2] By viewing through a small hole punched in the panel corresponding to the vanishing point, one can verify the reflection of the painting on a mirror held before it, with the scene of the real Baptistery. In the diagram of a reconstruction of the 'experiment,' clouds are drawn as doubly reflecting off of the mirror and then off of the painting itself. The cloud dually reflected, first in the mirror and then in the silver of Brunelleschi's painting, is a slippage of an ideal construct. The cloud discovered is not produced from the drawing construction; rather it is a verification of the limitations in a structure of exclusion.[3]

To draw clouds is inherently a paradoxical act; yet artists and scientists have drawn skies for millennia, setting themselves up for failure as soon as they made a solid mark. What did cloud elucidate that no other subject could replace? Nephology, the science of clouds and its experimental methodologies, is a model to design exact measures for inexact subjects. As writer Marcel Beyer states aptly, if you devote yourself to clouds and their study, you're lost, unless one changes perspective and regards nephology itself as the laboratory - as one of the 19th century's great laboratories of poetic and artistic theory.[4] *Changing perspective* not only implies revisiting cloud studies to extrapolate relationships between art and a science of optics, but also setting up drawing schemes for new kinds of vision to occur.

Drawing and writing share the term 'orthography.' *Ortho* – meaning the right way or the right angle, and *graphia* – to draw, inscribe or write with a point. In writing, it refers to a set of conventions for structuring a language, the symbols and rules for organizing the visual codes of which language is composed, literally "correct writing," or similarly, a correct patterning of symbols. Whereas in drawing, orthography is usually used in conjunction with 'projection.' Orthographic projection is a set of graphic conventions for mediating between three-dimensional shape and two-dimensional representations, and vice versa. Drawing to record clouds conflates the orthographies in drawing and writing. Luke Howard not only rationalized the skies by creating a nomenclature for clouds, he also designed a new orthography for cloud recognition.[5]

> "No sooner did nephologists attempt to solve the fundamental problem of registering clouds armed with a new device than they were forced to reflect on the characteristics of this new medium, on their own perspective and methodology, and on the subject of the research and the phenomenon to be registered – the cloud as 'subject.' From the very start, every stage of nephology has been accompanied by reflections on the activity of self; indeed, at times the study of clouds seems to be comprised first and foremost of self-examination."[6]

An experimental framework in depicting cloud is an exercise in designing a technical schema for representing and imaging the world. The documentation and subsequent analysis of clouds are thus the experimenters' exercises in devising drawing methods, which tend to fabricate clouds rather than record. They were master cloud modelers, literally constructing systems out of thin air. Drawing a cloud is the extreme case of making *a free shape conform to a systematic armature*; it is design drawing "at full stretch."[7] Cloud drawings are working objects through which conventions and processes of drawing across several disciplines may be discussed. In the following lectures, we examine three types of drawing through the methods of cloud physicist Masanao Abe, landscape painter Alexander Cozens and artist John Constable. Abe drew clouds, he used the technique of dual mapping and stereographic projection to analyze clouds in the photographs of his cinematographic studies, a process derived from observation; Cozens developed rules for drawing clouds, schemas for inventing new textural combinations relying strictly on graphical rules to simulate depth; and Constable appropriated the rules devised by Cozens to paint new clouds, which according to a scientist, violates the contract between an artist's role in service to natural science, which is to depict real clouds. Constable's paintings were considered "bad" cloud drawing.

On August 4, 1926, Japanese physicist Masanao Abe (1891 – 1966) documented a bizarre cloud over Mt.Fuji with a time-lapse camera that recorded an image every ten seconds. Abe arrived at the height and heels of cloud studies. Named fifteenth head of a samurai family, ironically, Abe devoted himself to research on the least precise thing the world had to offer. His bourgeois upbringing provided him access to new technologies in his youth, such as the first screenings of cinematography in Japan. Abe became increasingly fascinated by the potentials of the 'moving image.' Applying this passion into his research of clouds, he invented various devices to record meteorological phenomena. In 1927, he founded the Abe Cloud Air Current Research Observatory on the heights of Gotemba, at the foot of Mount Fuji. Over the course of the next twenty years, until the beginning of WWII, Abe created a significant archive of cloud images and models studying mountain clouds and air currents, by frequently hybridizing techniques of documentation and constructing his own instruments for analysis. He relied mainly on the budding techniques of cinematography to record cloud movement in consecutive shots. The space-time grid would prove to be instrumental in Abe's analysis work later in his career. *Figure 2* is a spread from his field study sketchbook with the framework he designed to analyze the cloud housed within the photograph. He would trace the edge of the cloud with a line and replace tonal contrast with notations and codes. Each page was also accompanied by data recorded on site, such as wind speed, pressure, temperature, etc. Although later in his work, he adopted labeling and line conventions from the International Cloud Atlas, he was the only cloud physicist to use arrows in his drawings to indicate projected vectors.

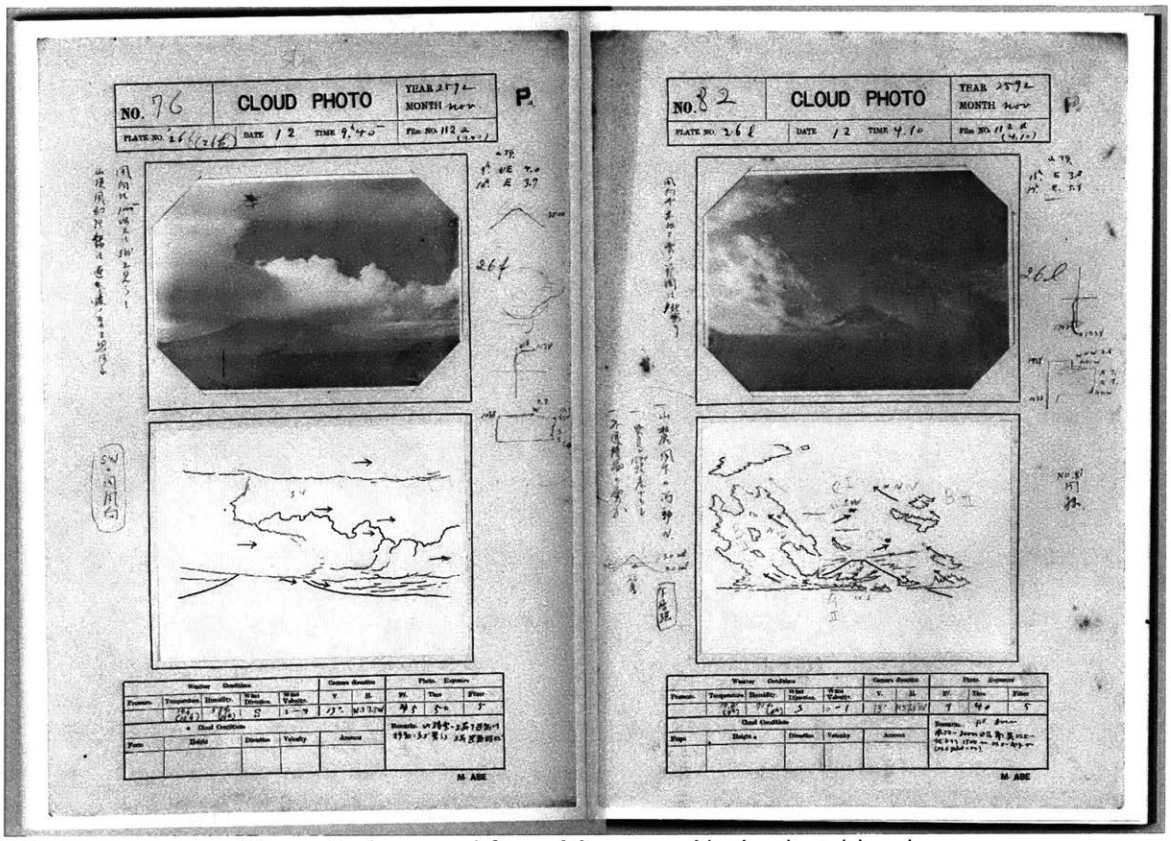

Figure 2: A spread from Masanao Abe's sketchbook.

There were also several instances in which Abe did not record anything; not that there was no content in the photograph, but because there was no observation made. Herbert Simon quotes Oscar Wilde on how there were no fogs on the River Thames until Turner, by painting them, revealed them to the residents of London.[8] In Abe's case, there is no cloud subject if it's not drawn. He was considered the 'Count of Clouds' and was dexterous moving between his technologies. He constructed an experimental model to stereoscopically align photographs he had taken with cameras next to each other. Abe was quick to adopt new techniques into his work, and was often criticized for the taboo of optimizing instruments while performing experiments. For example, he was one of the first scientists to place an entire landscape inside a wind tunnel. He combined the fields of fluid dynamics, aerodynamics and cloud science by placing a model of Mt. Fuji inside a wind tunnel to simulate cloud movement, and then analyzed the photographs from the simulation in parallel with photographs of real conditions. Because of his unconventional approach, his early work such as the *Cinematographic Studies of Rotary Motion of a Cloud Mass near Mt. Fuji* produced in 1927 were not recognized by the Japanese Meteorological Society as legitimate scientific research until his second submission a few years later. He is a designer of experiments, but also an experimental designer: his analytic and imaginative labors are fused and amplified with his practice as photographer, draftsman and modeler. His recognition in the field of climate sciences marks the significance of the production of images in contributing to scientific knowledge. However, Abe's contribution to cloud science never had the chance to gain wide recognition, as the entire field of cloud science was quickly forgotten. Atmospheric science replaced nephology after WWII and cloud studies were considered, struck with a similar fate as physiognomy, as a pseudoscience.[9]

Alexander Cozens is a landscape painter who defied the objectives of landscape painting. In his seminal work, *A New Method of Assisting the Invention in Drawing Original Compositions of Landscape*, he proliferated the method of "blotting," in which he defined as "the production of chance with a small degree of design."[10] Cozens methods align with a rich history of emergence as produced by artists. His desire to produce landscapes was neither to imitate old masters, nor to represent a unique reality. He sought a type of landscape that was completely out of the domains of current style: an "original landscape" that emerges, rather than merely exists.[6] Cozens even states that he is creating 'artificial representations of landscape' and as he simulates a space with rules, he allows the space to invent images of new landscape. He rendered a wholly unrecognizable landscape, irreducible in form. This instance of post-perspective exploration of the drawing surface produced a new kind of drawing – a computational drawing. In *New Methods*, Cozens included twenty engraved plates of invented cloud composition algorithms under each figure. Rather than capturing the cloud by drawing in situ, Cozens developed a system of cloud depiction that suspended drawing from representation. Maynard identified spatial issues in drawing in two main categories: spatial properties produced by drafter and spatial properties of subject matter.[11] Cozens used spatial properties produced by his drawing methods to invite an image of spatial properties of cloud into the landscape. His algorithms explore depth through texture.

A background is a key component in basic compositions – is it also a necessary field in which a foreground can emerge. Clouds are put to work in compositions to allow the sky to be seen.[12] The process of filtering primary information of a foreground from

the 'noisy' information of the background creates an image. Let us revisit 300-year-old algorithms for cloud depiction to explore the untapped potential in noisy backgrounds.

Engraving is a technology created for the purposes of mass reproduction. The replication of paintings became a ubiquitous technique deployed by artists to introduce images into the circulation of knowledge and for aesthetic education. Incidentally, in this process of modernization of tools to standardize representations, clouds being the background with the fewest definitions, became an experimental space for expressive facture that etching artists exploited as value. The artist's facture is the desired function or value of such a copy. Variability and uniqueness in technique became capital and culture.

Before we get to the truly "bad" cloud drawer, I'll interrupt myself with a note about the algorists. In 1995, computer artists Roman Verostko and Jean-Pierre Hébert suggested that the descriptive term "algorist" should be applied to anyone who creates artworks using an algorithm. They expressed the conditions in the Algorist Manifesto:

```
if (creation && object of art && algorithm && one's own algorithm) {
        include * an algorist *
}
elseif (!creation || !object of art || !algorithm || !one's own algorithm) {
        exclude * not an algorist *
}
```

Given the manifesto was written in pseudo-code, the term algorist was meant to be inclusive. As "object of art" can be interpreted in a variety of forms, and "algorist" can be applied to any one who uses rules to make structures, "be she a painter, a sculptor, a weaver, a composer, an actor or an architect." Allow me to highlight the immense creativity demanded now to fulfill the last requirement, "one's own algorithm", because the algorists' project here is not only to work algorithmically, but also to not sacrifice intuition and perception in algorithmic work. It also states nowhere that algorithmic work is dependent on the computer; the openness to medium allows algorithms be our common ground. Algorists existed long before the algorist manifesto. In *Landscape Coils* and subsequent drawn studies of grassy fields, Colette Bangert took on the project to depict computational grass by first producing hand drawn grass, and then Jeff Bangert studied the algorithmic structures in the drawing to produce rules to draw computer grass. The reverse engineering of a drawing not only revealed how to program grass to be expressed through a different medium, the computer, but also introduced the algorithm as the common ground to understand the artist's process of observing and drawing. It may be taboo to post-rationalize, but I consider Alexander Cozens an algorist.

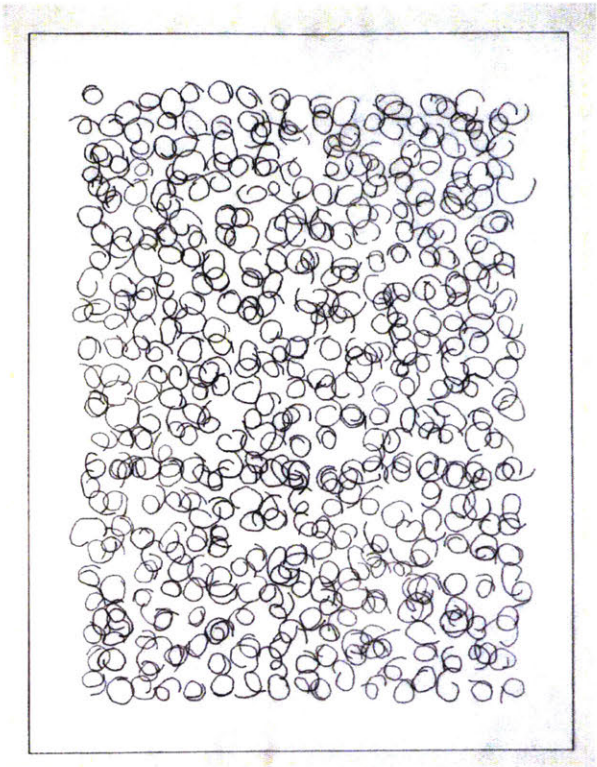

Figure 3: Colette and Jeff Bangert, *Landscape Coils*, 1967.

John Constable, who would later coin his cloud depiction method as 'skying' in 1821, appropriates schemas for skyscapes developed by Cozens in 1785. Some of his compositions were based on completely fictional depictions of clouds. Artist Gerhard Lang photographs the sky from Constable's own doorstep, to find out whether "Constable's clouds are still passing." If he knew the truth of Constable's skies, he would not be looking for clouds in the sky, or even in reality.[13]

Now I will clarify what it means to draw poorly. William Clement Ley, a meteorologist and inspector for the British Meteorological Office, gave a series of lectures on "Clouds and Weather Signs," in which he outlined many problems within the field of nephology at the time, but provided few solutions. Most notable of his complaints, was his relationship with artists; he acknowledged their shared interest in nephological research but condemned artists for not fulfilling their base responsibilities to be the draftsmen of science. According to Ley, there are three ways an artist might draw "bad" clouds:

1. guided by "the eye of the public, to whom a cloud is a camel, weasel, or whale shaped mist, and nothing more", so a the person has no observational skill, their eye is not trained;
2. no skill in depiction or precision (the person is knowledgeable of cloud science, but their hand is not trained);
3. painters who pursue cloud studies with "an eye of a natural scientist, and who do not lack art' but 'when facing the canvas are clearly obsessed with painting bad clouds'; they do not 'see wrongly, but they depict 'wrongly, and that will full intent' (the person is well trained but have no interest in using these skills to contribute to scientific

observation or recording. Instead, they draw and paint sublime cloudscapes that the scientists do not recognize at all.) It is obvious that Constable was not a bad painter: he was one of the greatest masters of painting in early 19th century. But he was precisely the good kind of "bad" cloud drawer. He adopted Cozen's rules to generate for himself new "clouds" regardless of the reality of clouds. In design representation, it is easy to default into the common dichotomy between digital and analog techniques by equating the tool to technology. As demonstrated in Cozen's case, his method is combinatoric, hence discrete. Deleuze suggests in *Francis Bacon: Logic of Sensation*, that digitality finds its origins in our [hand] digits; my mother is no Rosalind Krauss but even she makes a good point about how our five digits are not the same length, so how can we agree on a homogenous base unit? Is discretization enough to define digitality? It is also easy to assume working algorithmically, is working creatively.

The following exercises are situated at the conflation between digital translations of analog draw and analog interventions into digital draw. By selecting cloud as the subject of investigation, students are deprived of any stock moves: be it algorithmically, computationally, analogically. There is no referent object, because it is an investigation into method.

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[1] Beyer, *Cloud Studies*, 124.
[2] Damisch, *A Theory of /Cloud/*, 121. Antonio Manetti's biography of Brunelleschi being the only record of existence of such panels.
[3] Damisch, *A Theory of /Cloud/*.
[4] Völter, *Cloud Studies*.
[5] Howard, *On the Modification of Clouds*. 1802.
[6] Beyer, *Cloud Studies*, 125.
[7] Evans, *Projective Cast*, 133. "...what else, in other words, but things already defined and made according to the regulative lines and planes of classical geometry? The answer is everything and nothing. Nothing else can be projected by Alberti's construction, unless previously reduced to a reticulated armature. But everything else can be sketched in the boxes thus provided. Hubert Damisch asks us to consider clouds, an extreme case."
[8] Simon, *Sciences of the Artificial*, 1996. "Oscar Wilde once claimed that there were no fogs on the River Thames until Turner, by painting them, revealed them to the residents of London. In the same way our atmosphere contained no noxious substances in quantities of a few parts per million until chromatography and other sensitive analytic techniques showed their presence and measured them. DDT was an entirely beneficent insecticide until we detected its presence in falcons' eggs and in fish. If eating the apple revealed to us the nature of good and evil, modern analytic tools have taught us how to detect good and evil in minute amounts and at immense distances in time and space."
[9] Daston. *Cloud Physiognomy: Describing the Indescribable*.
[10] Cozens, *A New Method of Assisting the Invention in Drawing Original Compositions of Landscape,* 1786.
[11] Maynard, *Drawing Distinctions*. 2005.
[12] "...or rather, children's drawings of the sky, in which clouds are put to work, employed to express the presence of the sky. They may be obscure and obscuring things, but, in such pictures, clouds let the sky be seen." Sadie Plant, "Something in the Air." *The Movement of Clouds*. 2016.
[13] Plant, "Something in the Air." 2016.

I. Observation, a decomposing of sky

"To perceive a visual image implies the beholder's participation in a process of organization. The experience of an image is thus a creative act of integration. Its essential characteristic is that by plastic power an experience is formed into an organic whole. Here is a basic discipline of forming, that is, thinking in terms of structure, a discipline of upmost importance in the chaos of our formless world. Plastic arts, the optimum forms of the language of vision, are, therefore, an invaluable educational medium." - Gyorgy Kepes, 1976[1]

This lecture is concerned with what may strike some as an uncharacteristically impractical subject, with equally impractical applications.[2] I am speaking of clouds, and in particular, the tension between observational techniques and the recording of clouds. Here, a scene of an impossible conversation between 15th century architect and Renaissance engineer Filippo Brunelleschi and 20th century cloud physicist Masanao Abe, staged to present to you a conflict in imaging methodologies in scientific and artistic experimentation. We enter the scene with Brunelleschi vehemently convincing Abe that the perspectival method is sufficient to uphold all the geometries we need in representation.

FILIPPO BRUNELLESCHI isn't overtly insecure, but you wouldn't want to challenge his principles. **MASANAO ABE** isn't especially cavalier, but his tendencies are rather unorthodox. A classroom, some chairs. Architect's drawing board and some cameras, perhaps.

BRUNELLESCHI (Frantically drawing diagrams on the chalkboard. In a mass of figures, one can spot the diagram of Brunelleschi's first perspectival experiment. Measuring, figuring things out.)

ABE No matter how precise your lines, they are not going to accommodate the clouds –

BRUNELLESCHI (Stops drawing. Turns around.)
Abe, my dear friend. Do you not see that these lines match directly?
(Points at drawing.)
I have got to be the expert of this by now. Although, I would like to remind you, that *you* are the scientist here.

ABE Yes, and I, the scientist, is telling you that clouds do not fit into your rules. You cannot simply apply the perspectival grid onto a cloud and call it a system for cloud depiction. This technique is not calibrated for measurement or even proper observation; your painting lining up with an occurrence in reality was merely a coincidence.

BRUNELLESCHI Observation in the 15th century was a bigger endeavor perhaps, without these devices to help me...
(Gazes as cameras.)
But you cannot deny that my experiment was revolutionary for the rationalization of observation. Shoving the world into a few points and lines, as crude as that may sound, completely shifted conceptions of space and depth. This drawing system even

provided the viewing subject a body, a Renaissance body, with an awareness of place and distance. What are a few clouds in comparison to the achievements of this system otherwise?

ABE Indeed, it is a powerful tool, yet you admit that it cannot accommodate clouds. Which means I cannot use it. Your depiction of the sky is not depiction at all!

BRUNELLESCHI But my experiment –

ABE It was not an experiment.

BRUNELLESCHI (Slighted.)

Let me explain to you, *Count of Clouds*, how I set up the experiment, once again. I draw a horizon line, I place a vanishing point on the horizon line, I project a series of lines towards the vanishing point that produces the illusion of ground, I paint my view of the baptistery of San Giovanni according to these angles and lines, I hold up my painting of the baptistery of San Giovanni facing away from me, and look through the hole in the painting corresponding to the vanishing point into a mirror, allowing me to see the reflection of the painting, and by aligning my view with the baptistery, I can verify that my painting can be dual mapped onto the real view. All the elements matched perfectly, even the clouds.

ABE So how did you paint the clouds?

BRUNELLESCHI I didn't! I painted the sky with darkened silver, so the natural air, sky and clouds could be mirrored exactly like a real view.

ABE Exactly. It was a *demonstration*. You made no effort in devising rules for drawing or painting clouds. There was only observation and no recording, how can you call that an experiment in cloud depiction?

BRUNELLESCHI But even Vasari agreed that this system of depiction was an "ingenious procedure" that would define all space![3] The silver on the painting is to acknowledge the reality of the clouds. Demonstration, experiment or what have you, the silver allows for the true nature of clouds to exist within my system, without reducing the subject to definitions. It is cloud, no matter shape or form.

ABE Even clouds require definition. They are the extreme case in a representational system. Drawing the cloud from my photographs is crucial to my analysis of their behavior. Allowing the chaos of natural clouds to exist in your painting is avoiding a challenge, and also forgoing an opportunity to test the capacity of your drawing system to become truly inclusive of *everything.*

BRUNELLESCHI Then may you please elaborate on the correct way to experiment with clouds? These artifacts you concocted in your wind tunnel –

(Points at photographs from the wind tunnel.)

These are merely demonstrations, as well? You put *a landscape* into a wind tunnel. No one has ever tried to do that.[4] You would consider the clouds in the

simulation just as legitimate, if not more valuable as evidence than the clouds in the sky. I can barely differentiate between the two.

ABE If we were speaking of simulations, I would consider your demonstration also an exercise in virtuality. I'm not an expert on clouds in general; I have no interest in claiming the skies as Luke Howard did. I do not study every cloud; I do not even photograph every cloud. The objects of my experiment, to be precise, are the photographs of the clouds rather than the clouds themselves. Stereoscopic recording is a key method my research. While I realized that a standard stereo camera was not enough to deal with the distance between my observation station and Mount Fuji, as the gap between the lenses were too small and could produce no effect of spatial perspective, I constructed two observation stations 500 meters apart from each other to record at the same time. But when it came to constructing a stereographic image, 500m had to translate back into the distance between two eyes...the observer would then become a 14,500m tall giant, or Mount Fuji would be a 50cm high hill.[5] The scaled stereoscopic grating system is a three-dimensional observation tool that I designed specifically for cloud observation at the distance, height and angle as set up by my experiment. It is an instrument borne out of the specifics of a context, rather than an application of a standardized tool. This is where our worlds conflate.

BRUNELLESCHI You're forced to depict in perspective.

ABE Yes, I was forced into your world of shards that enabled the creation of wondrous things, such as checkered floors. No wonder you were so popular.

BRUNELLESCHI But you agree with my resistance to standardizing cloud depiction. When perception becomes habitual, it becomes automatic.[6] My method in rationalizing space is *in support* of truth to species in observation. This art of measuring is not caricaturizing the specificities important to experimentation, rather it is allowing things, not pre-defined objects, to coexist in an image. You wanted to preserve as many natural qualities of clouds as possible in your tool, so did I.[7] Clouds served their simple purpose of providing me a realistic background, I am satisfied with my results.

ABE Background is everything. Recording is the process of extracting information from the noise of the surrounding world.

BRUNELLESCHI I would probably regret mentioning him, but Leon Battista Alberti wrote the first treatise between art and optical science in 1435, but I was practicing codified perspective methods already in my work. The sky is not there until clouds are added, the clouds worked to reveal the sky. Honestly, if any other object could serve the purpose of signification, I would use it. You and your clouds are killing me, Abe. Why do you care? What is it about cloud that is worth dismantling my world –

(Gestures towards diagrams.)

ABE Perhaps a comparison can be drawn between my obsessions and Alfred Stieglitz creating *Equivalent*, his series of sky photographs produced just a few years before I began my recordings. I admit: I am guilty of succumbing to the mechanization of vision enabled by cinematography. My first experience with 'moving photographs' left me wondering about three things: the duration of an image, the material of the image,

scratches on film that initially seemed like rain, and the flickering of consecutive frames. It is this passion for novel qualities of vision produced through cinema that really propelled me into the study of clouds. I was interested in using film to study natural phenomena – I think it would be closer to the truth to say that for many years, I'd been more fascinated by cinema than by clouds.[8] The images produced in my pursuit of clouds and their ability to recreate the reality of a world became the true subjects of my science... In the end, Stieglitz was only using cloud as a prop to experiment with the qualities of the photographic image.

BRUNELLESCHI Then what do you love, you extraordinary stranger...[9] You accuse me of being too enamored with converging lines?

(Exit.)

---

[1] *Language of Vision*

[2] Opening statement. Luke Howard, *On the Modification of Clouds*, 1802.

[3] Damisch, *A Theory of /Cloud/*, 122.

[4] Völter, *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe,* 2016.

[5] "Strictly speaking, this three-dimensional view is an artificial effect that does not correspond to what one perceives with the naked eye. If the 500m distance between the cameras were to equate to the distance between the eyes, then the observer would be a 14,500m tall giant, or, using a different calculation, Fuji would be a 0.5m high hill at a distance of 2.5m." Völter, *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe,* 2016.

[6] Viktor Shklovsky, *Art as Technique*, 1917.

[7] Daston and Galison, *Objectivity*, 2010.

[8] Völter, *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe,* 2016.

[9] Charles Baudelaire, 1862.

II. Algorithms, appropriation

(As written in *A New Method of Assisting the Invention in Drawing Original Compositions of Landscape* by Alexander Cozens. Grouped according to method.)

17. All plain, darker at the top than the bottom, gradually.

18. Streaky Clouds at the top of the Sky.
19. Streaky Clouds at the bottom of the Sky.

20. Half Cloud half plain, the Clouds darker than the plain or blue part & darker at the top than the bottom.
21. The same as the last, but darker at the bottom than the top.

22. Half cloud half plain, the clouds lighter than the plain part, & darker at the top than the bottom.
The Tint twice over in the plain part, & once in the clouds.
23. The same as the last, but darker at the bottom than the top.

24. Half cloud half plain, the lights of the clouds lighter, and the shades darker than the plain part and darker at the top than the bottom.
The Tint once over in the plain part, and twice in the clouds.
25. The same as the last, but darker at the bottom than the top.

26. All cloudy, except one large opening, with others smaller, the clouds darker than the plain part, & darker at the top than the bottom.
The Tint twice over.
27. The Same as the last, but darker at the bottom than the top.

28. All cloudy, except one large opening, with others smaller, the clouds lighter than the plain part, & darker at the top than the bottom.
The Tint twice in the openings, and once in the clouds.
29. The same as the last, but darker at the bottom than the top.

30. All cloudy, except one large opening, with other smaller, the lights of the clouds lighter & the shades darker than the plain part, and darker at the top than the bottom.
The Tint once over in the openings, and twice in the clouds.
31. The same as the last, but darker at the bottom than the top.

32. All cloudy, except a narrow opening at the bottom of the sky, with others smaller, the clouds lighter than the plain part, and darker at the top than the bottom.
The Tint twice in the openings & once in the clouds.
33. All cloudy, except a narrow opening at the top of the sky, with others smaller, the clouds lighter than the plain part, & darker at the bottom than the top.
The Tint twice in the openings, & once in the clouds.

34. All cloudy, except a narrow opening at the bottom of the sky, with others smaller, the clouds darker than the plain part, and darker at the top than the bottom.
The Tint twice over.

35. All cloudy, except a narrow opening at the top of the sky, with others smaller, the clouds darker than the plain part, & darker at the top than the bottom.

The Tint twice over.

36. The same as the last, but darker at the bottom than the top.

III. Systems, resolving depth

Graphical grids are used extensively in the capturing of cloud shapes. John Ruskin dedicated a chapter *On Cloud Beauty* in *Modern Painters* that outlined the proper way to manifest the sky through various projection techniques of perspective. His speculations are coupled with anecdotes regarding the physical movements of clouds. Although *Modern Painters* is not a scientific document in the natural sciences, his seeking out of a 'truth of species' in the depiction of natural phenomenon runs parallel with the notion using working objects in scientific experimentation to standardize subjects of observation. Ruskin described his grids as "cloud nets" and praised J.W. Turner as the only artist who mastered cloud-drawing.[1] Cloud as subject presents foreign qualities to drawing forms, such as movement, directionality and the various maneuvers to break depth; simultaneously, systems of drawing are subject to constraints beyond mathematical definitions – limitations in biologically and socially specific contexts affect the legibility of drawings to human users.[2]

The modern world is a drawn one.[3] A "substrata" of drawings produce the component parts of everyday objects, which then combine into mechanisms that do not necessarily have holistic representations.

---

[1] "...that Turner stands more absolutely alone in this gift of cloud-drawing, than in any other of his great powers. Observe, I say, cloud-*drawing*; other great men colored clouds beautifully; none but he ever drew them truly: this power coming from his constant habit of drawing skies, like everything else, with the pencil point." Ruskin, *On Cloud Beauty, Modern Painters Volume V,* year.

[2] "...perception of depth in a picture on a flat surface depends upon a cultural background not shared by all people." Maynard, *Drawing Distinctions.*

[3] Maynard, *Drawing Distinctions.*

Bibliography

Benjamin, Walter. *The Author as Producer.* Vol. 2, in *Walter Benjamin: Selected writings, 1931 - 1934*, by Walter Benjamin, edited by Michael W. Jennings, Howard Eiland and Gary Smith, translated by Rodney Livingstone and others, 765-782. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1999.

Bredekamp, Horst, Vera Dünkel, and Birgit. Schneider, . *The Technical Image: A History of Styles in Scientific Imagery.* Chicago: The University of Chicago Press, 2015.

Bridle, James. *Cloud Index.* September 2016. http://cloudindx.com/ (accessed October 2016).

Canales, Jimena, Harun Farocki, Hilde Van Gelder, and et al. *Harun Farocki & Trevor Paglen: Visibility Machines* . Edited by Niels Van Tomme. Baltimore: Center for Art, Design and Visual Culture, UMBC, 2015.

Cozens, Alexander. *A New Method of Assisting the Invention in Drawing Original Compositions of Landscape.* Paddington Press Ltd., 1785.

Crary, Jonathan. *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century.* Cambridge, Massachusetts: MIT Press, 1990.

Curley, John J. "Pure Art, Pure Science: The Politics of Serial Drawings in the 1960s." In *Infinite Possibilities: Serial Imagery in 20th Century Drawings*, 25-36. Wellesley, Massachusetts: Davis Museum and Cultural Center, 2004.

Damisch, Hubert. *A Theory of /Cloud/: Toward a History of Painting.* Translated by Janet Lloyd. Stanford, California: Stanford University Press, 2002.

—. *Noah's Ark: Essays on Architecture* . Edited by Anthony Vidler. Cambridge, Massachusetts: MIT Press, 2016.

Daston, Lorraine, and Peter. Galison. *Objectivity.* New York: Zone Books, 2007.

de Warren, Nicolas. "Ad Infinitum: Boredom and the Play of Imagination." In *Infinite Possibilities: Serial Imagery in 20th-Century Drawings*, 1-14. Wellesley, Massachusetts: Davis Museum and Cultural Center, 2004.

Dorrian, Mark. *Writing on the Image: Architecture, the City and the Politics of Representation.* London: I.B.Tauris & Co., 2015.

Galison, Peter. *Image & Logic: A Material Culture of Microphysics.* Chicago: The University of Chicago Press, 1997.

Gansterer, Nikolaus. *Drawing a Hypothesis: Figures of Thought.* Springer-Verlag/Wien, 2011.

Gombrich, Ernst. *Art and Illusion: A Study in the Psychology of Pictorial Representation.* Princeton, New Jersey: Princeton University Press, 1960.

Goodman, Nelson. *Languages of Art: An Approach to a Theory of Symbols.* New York: Bobbs-Merrill Company, Inc., 1968.

Hamblyn, Richard. *The Invention of Clouds: How an Amateur Meteorologist Forged the Language of the Skies.* London: Picador, 2001.

Hara, Hiroshi. *Hiroshi Hara: Wallpapers.* Tokyo: Gendaikikakushitsu, 2015.

Jones, Caroline, and Peter Galison, . *Picturing Science, Producing Art.* Routledge, 1998.

Kentridge, William, and Rosalind. C. Morris. *That which is not Drawn: Conversations.* Calcutta: Seagull Books, 2014.

Kentridge, William. *Six Drawing Lessons.* Cambridge, Massachusetts: Harvard University Press, 2014.

Kittler, Friedrich A. "Computer Graphics: A Semi-Technical Introduction." *Grey Room*, no. 02 (Winter 2001): 30-45.

Krauss, Rosalind E., and Yves-Alain Bois. *Formless: A User Guide.* New York: Zone Books, 1997.

Mattern, Shannon. "Cloud and Field." *Places Journal.* August 2016. https://placesjournal.org (accessed September 2016).

Maynard, Patrick. *Drawing Distinctions: The Varieties of Graphic Expression.* Ithaca, New York: Cornell University Press, 2005.

Mitchell, W.J.T. *Picture Theory: Essays on Verbal and Visual Representation.* Chicago: The University of Chicago Press, 1995.

Mitchell, W.J.T., and Mark B.N. Hansen, . *Critical Terms for Media Studies.* Chicago: The University of Chicago Press, 2010.

Readings in Art and Design Education. *Writing on Drawing: Essays on Drawing Practice and Research.* Edited by Steve Garner and John. Steers. Bristol: Intellect Books, 2012.

Richardson, Lewis Fry. *Weather Prediction in Numerical Process.* Cambridge: The Cambridge University Press, 1922.

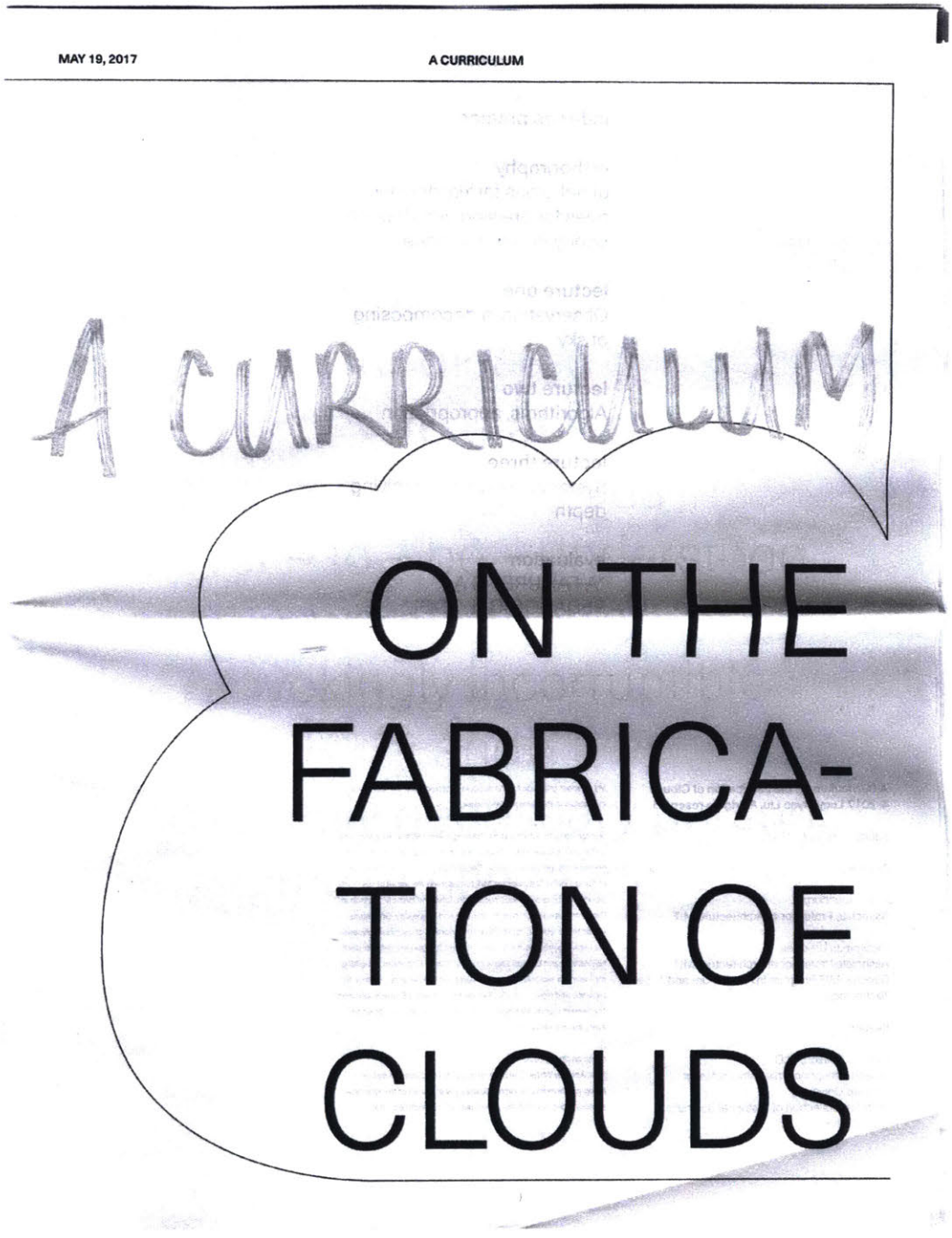
Simon, Herbert Alexander. *The Sciences of the Artificial.* Third. Cambridge, Massachusetts: MIT Press, 1996.

Snow, Charles P. *The Two Cultures and the Scientific Revolution.* New York: Cambridge University Press, 1959.

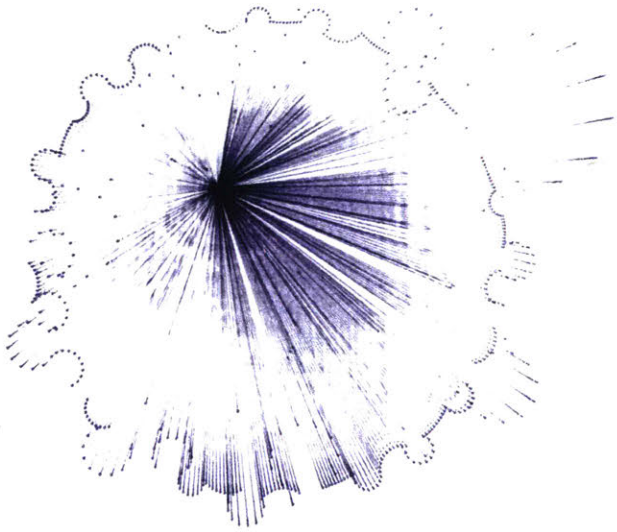
Völter, Helmut. *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe.* Leipzig: Spector Books, 2016.

Völter, Helmut. *Wolkenstudien. Cloud Studies. Études des nuages.* Leipzig: Spector Books, 2014.

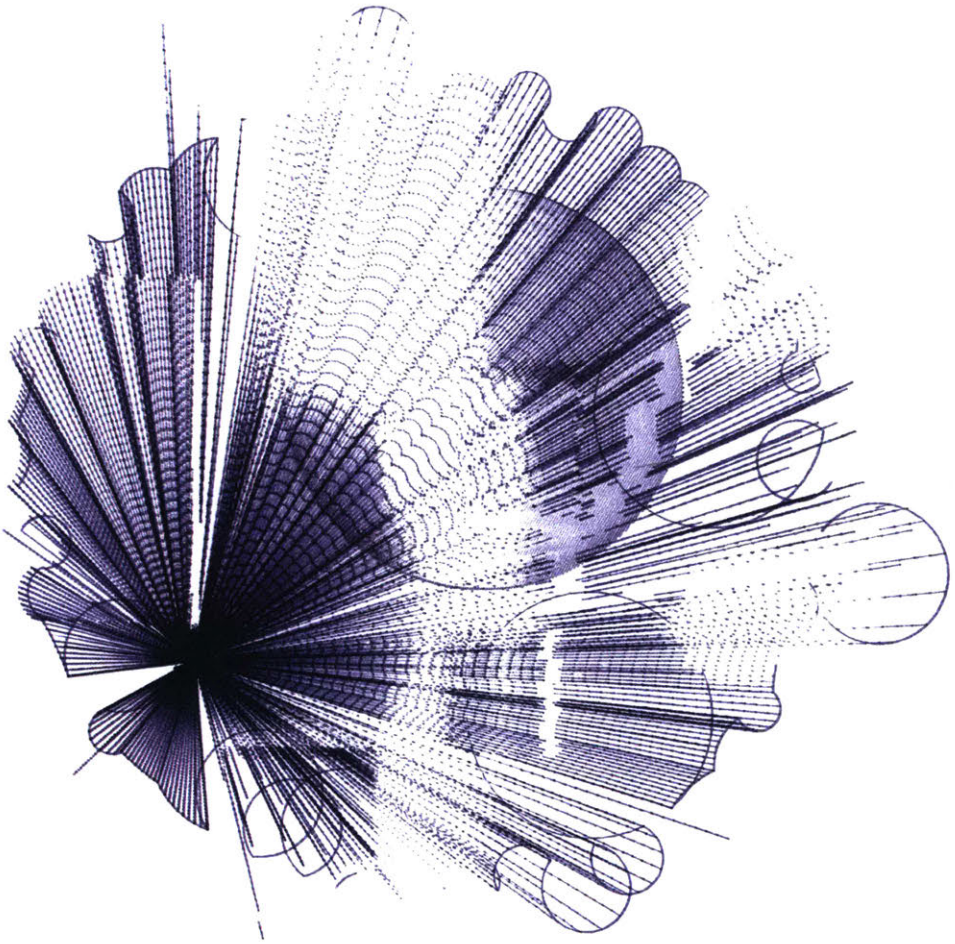
DRAWN SAMPLES



Refer to attached workbook, *A Curriculum on the Fabrication of Clouds*, for corresponding methodologies.



Cloud Hole
***Algorithms,* Cozens 28.**



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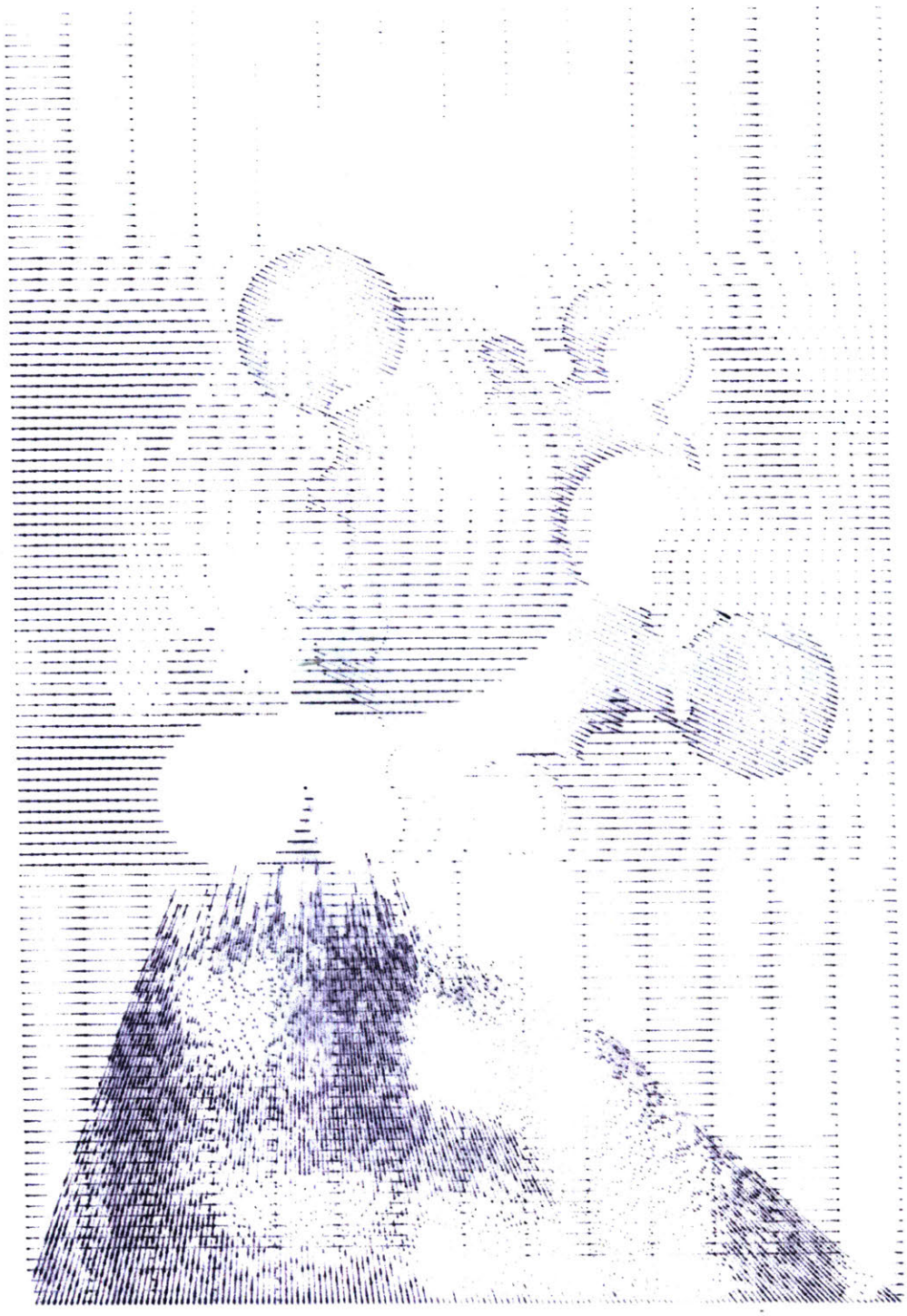
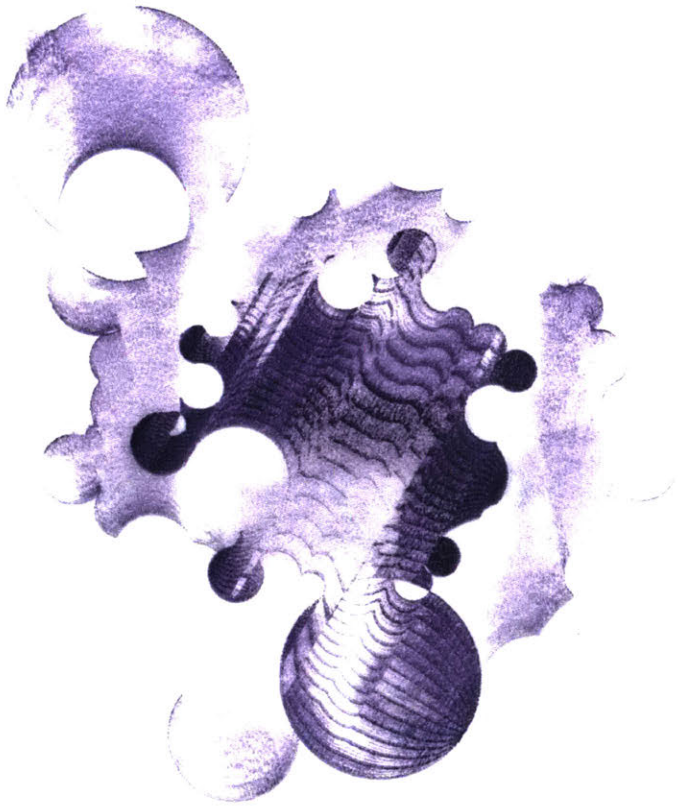
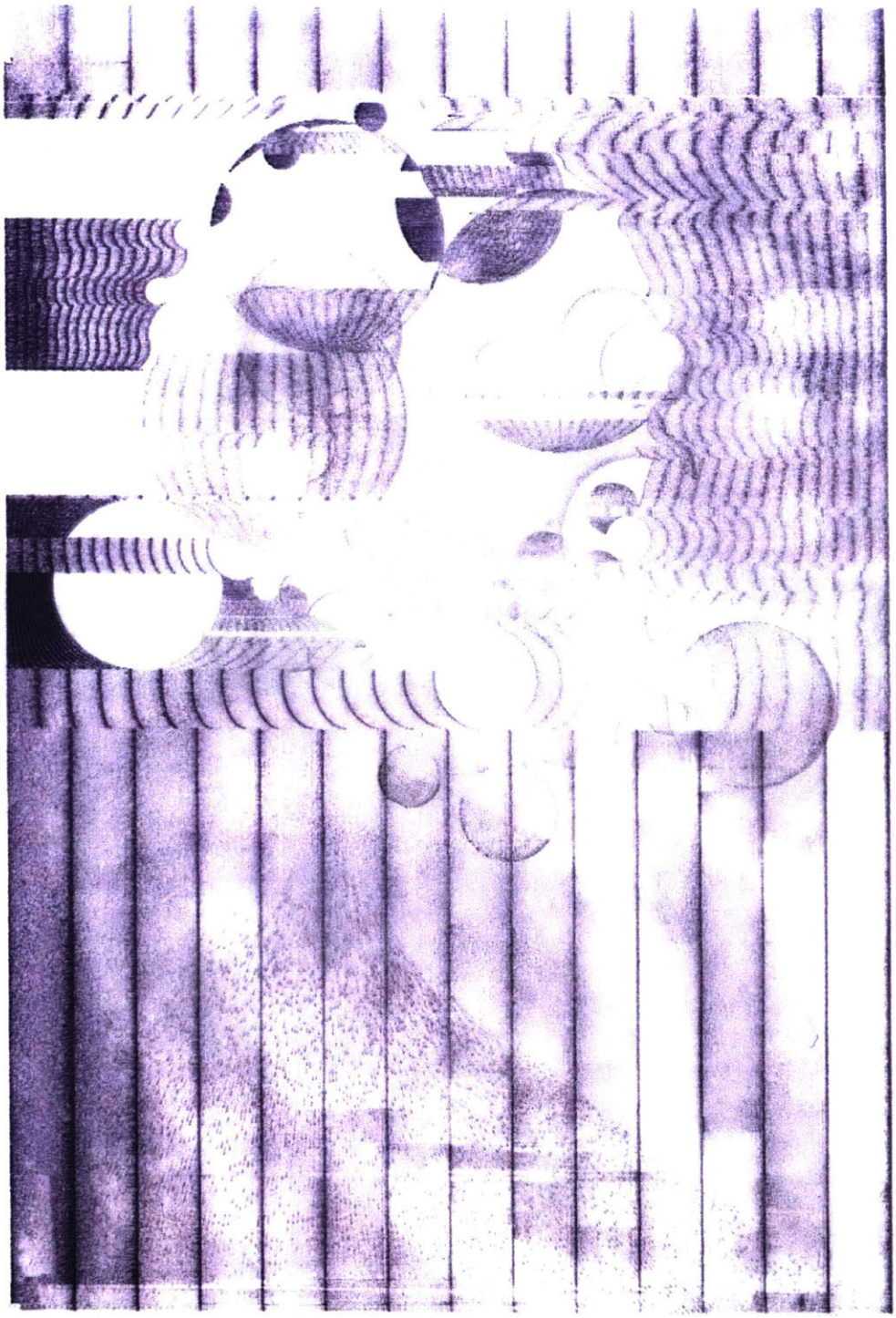


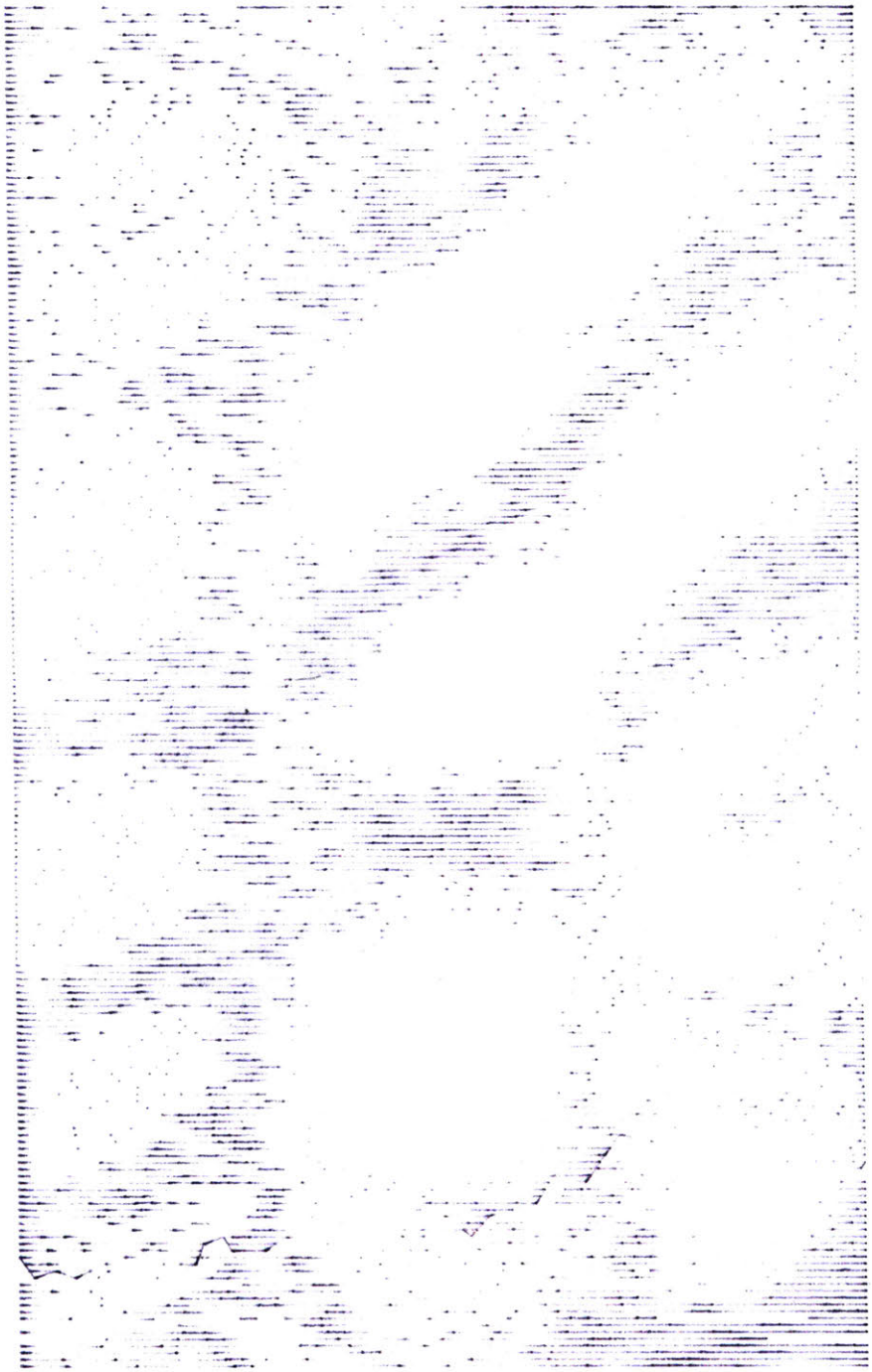
All Plain, Streaky Clouds, Cloud Hole and a Mountain
***Algorithms*, Cozens 17 and Cozens 24.**



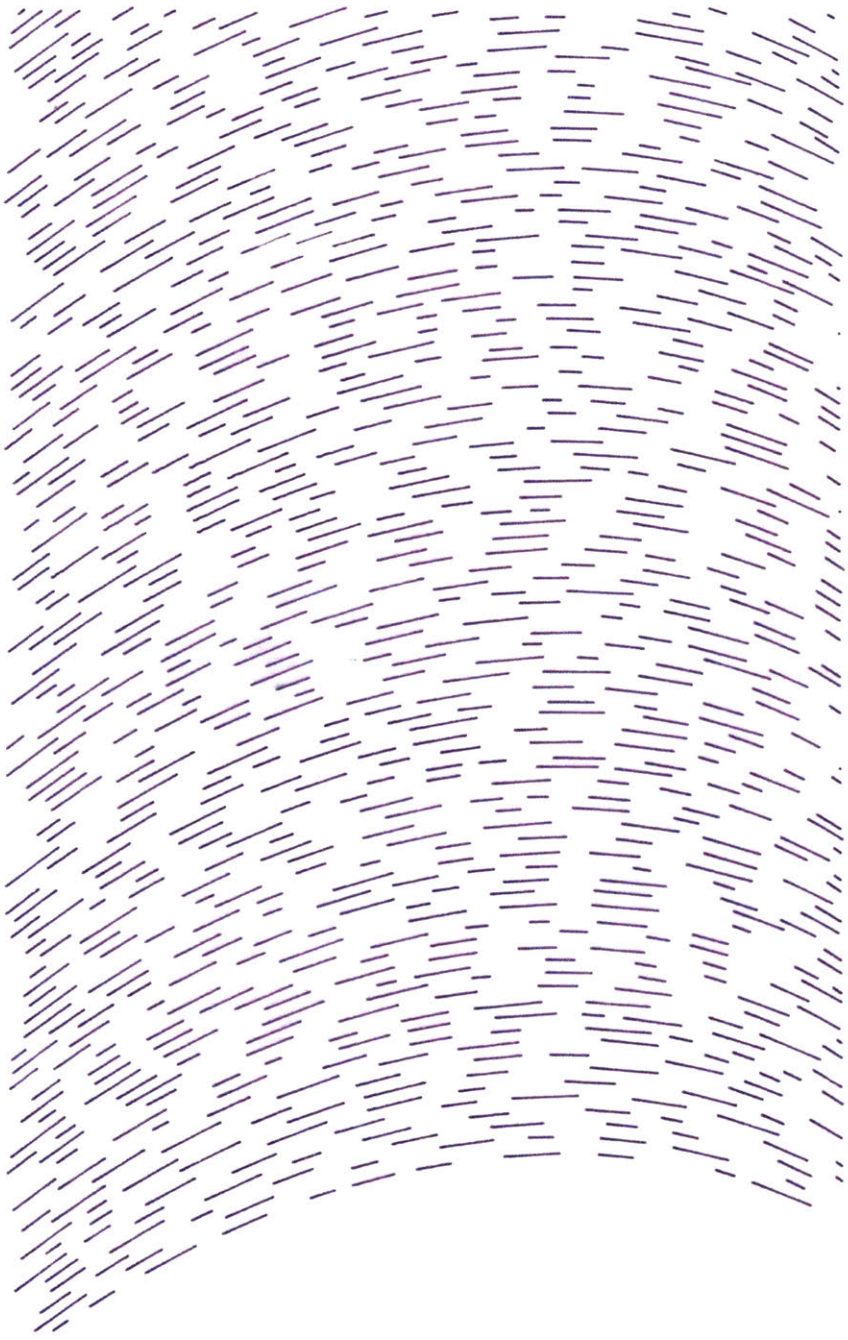
Cloud Hole, Tint Twice Over
***Algorithms*, Cozens 29.**



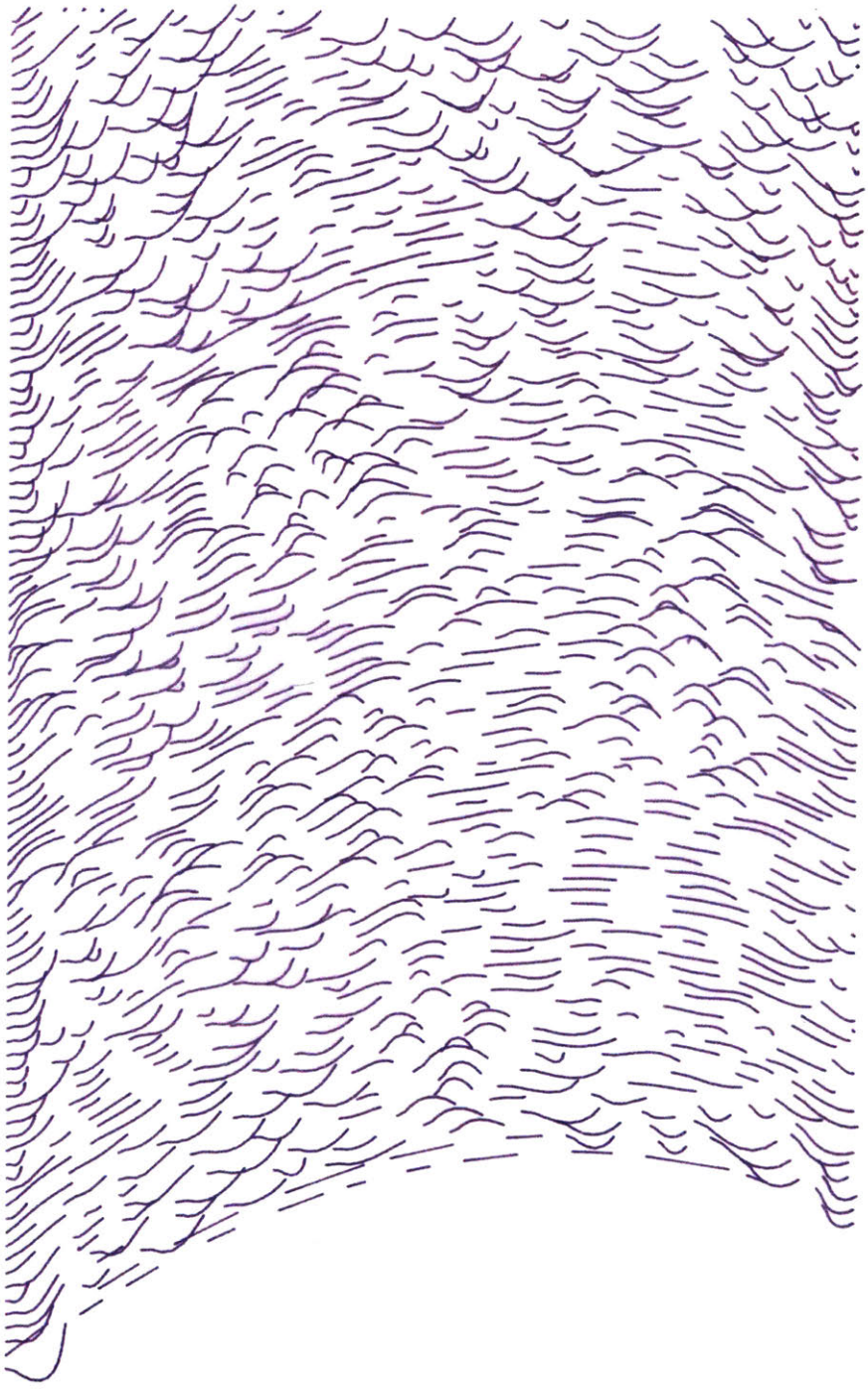
All Cloudy, except one large opening
***Algorithms*, Cozens 30.**



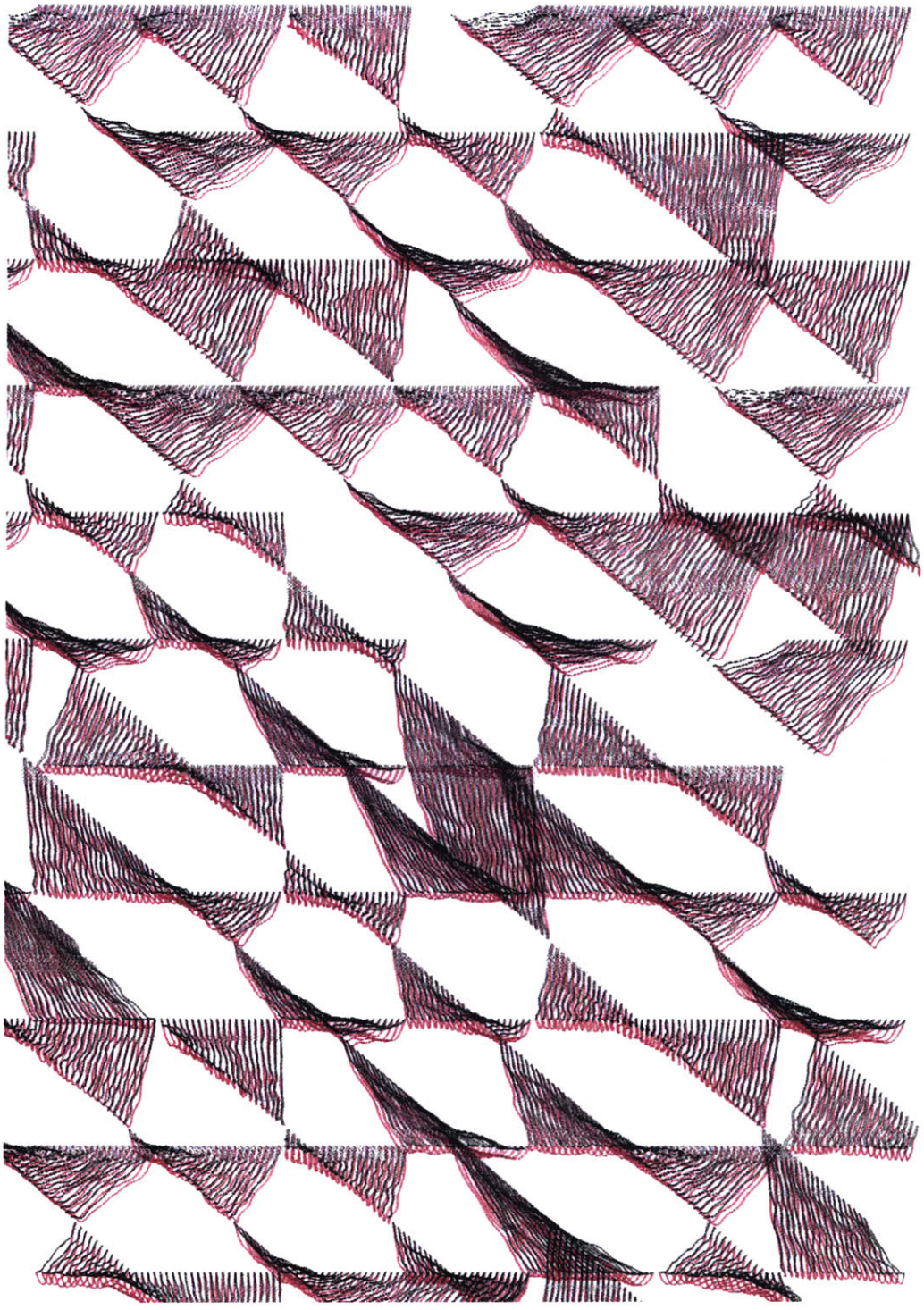
Half Cloud Half Plain
***Algorithms*, Cozens 20.**



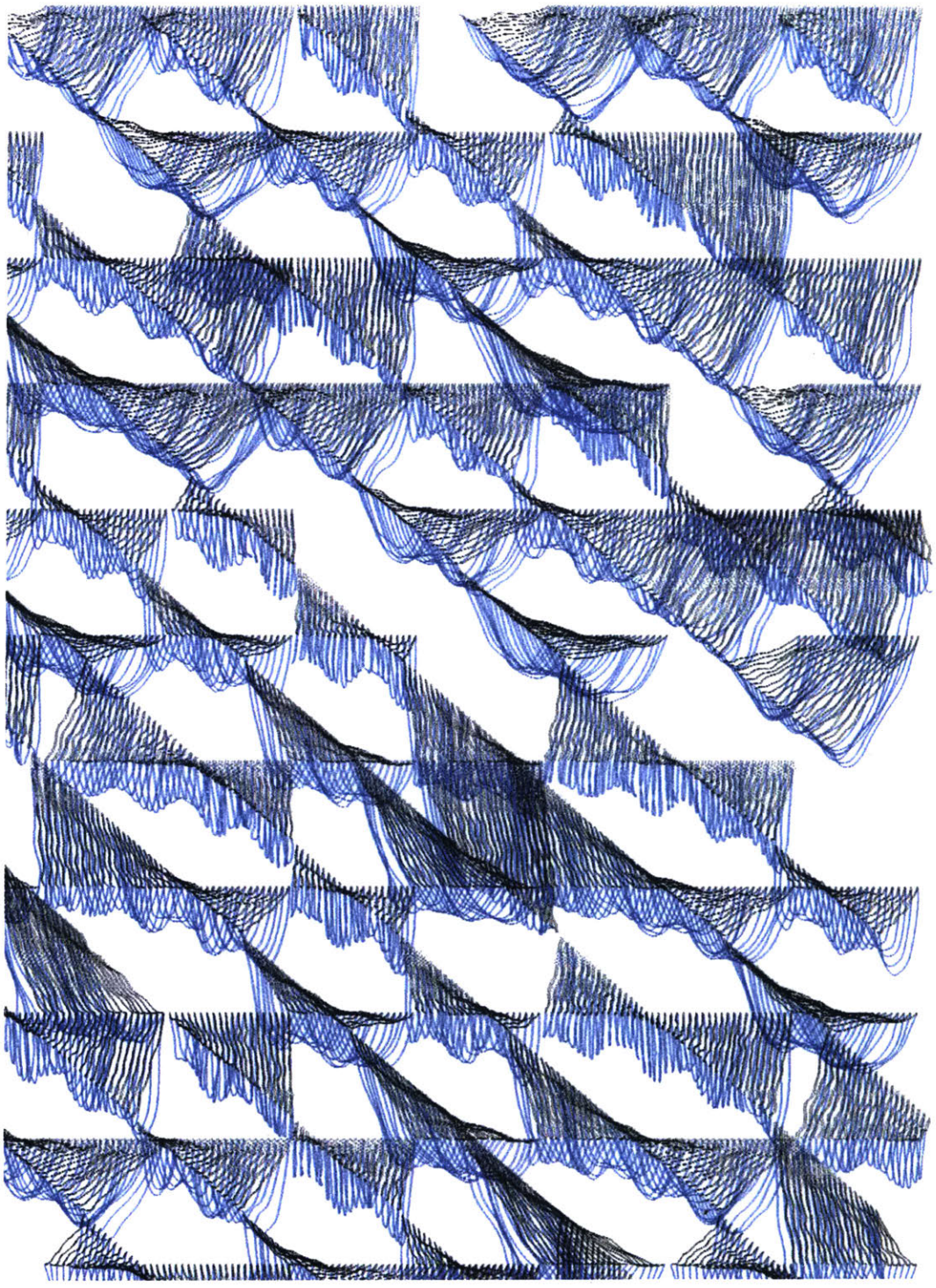
Streaky Clouds at the top of the Sky
***Algorithms,* Cozens 18.**



**Streaky Clouds at the top of the Sky,
slightly windy
Algorithms, Cozens 18.**



Instance 11 + 19
***Systems,* Ruskin Rectilinear 1.**



Instance 11 + 34
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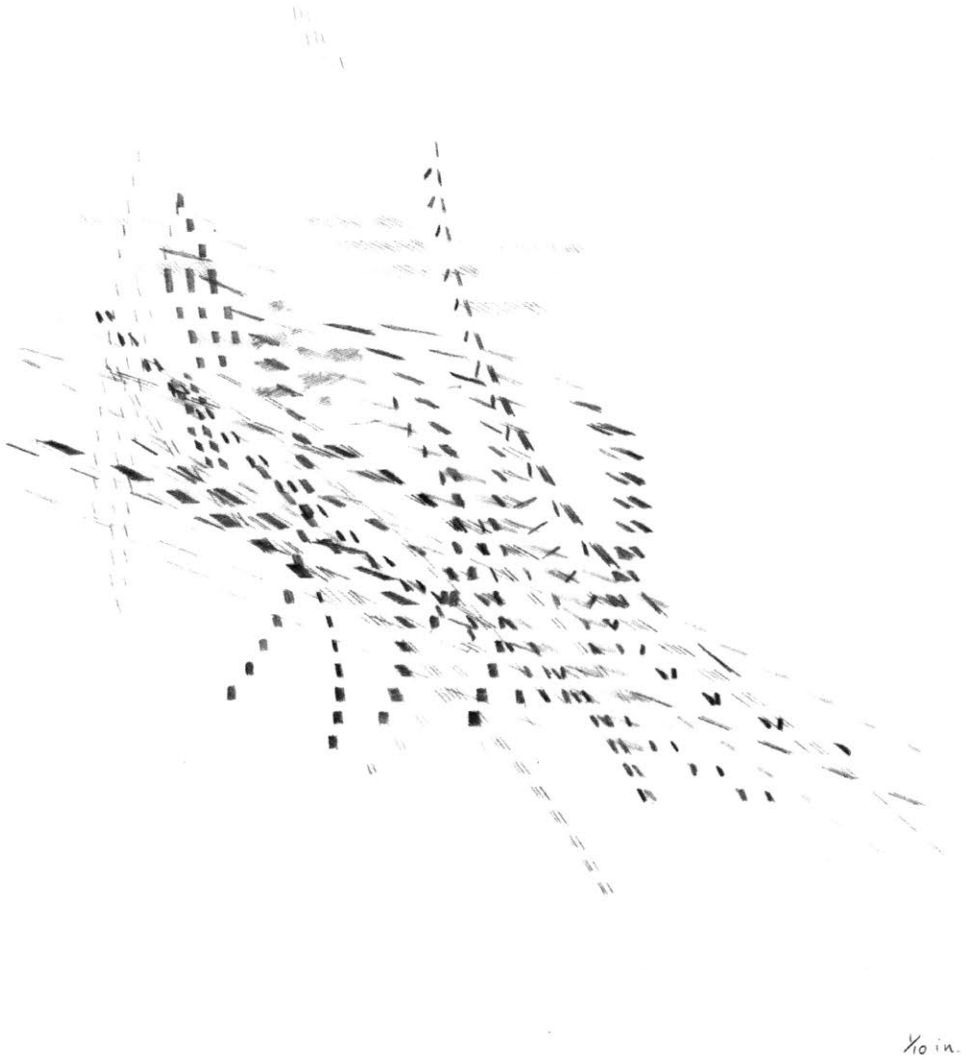

***Observation,* Abe.**

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Dual Map Sketch
***Observation,* Abe.**

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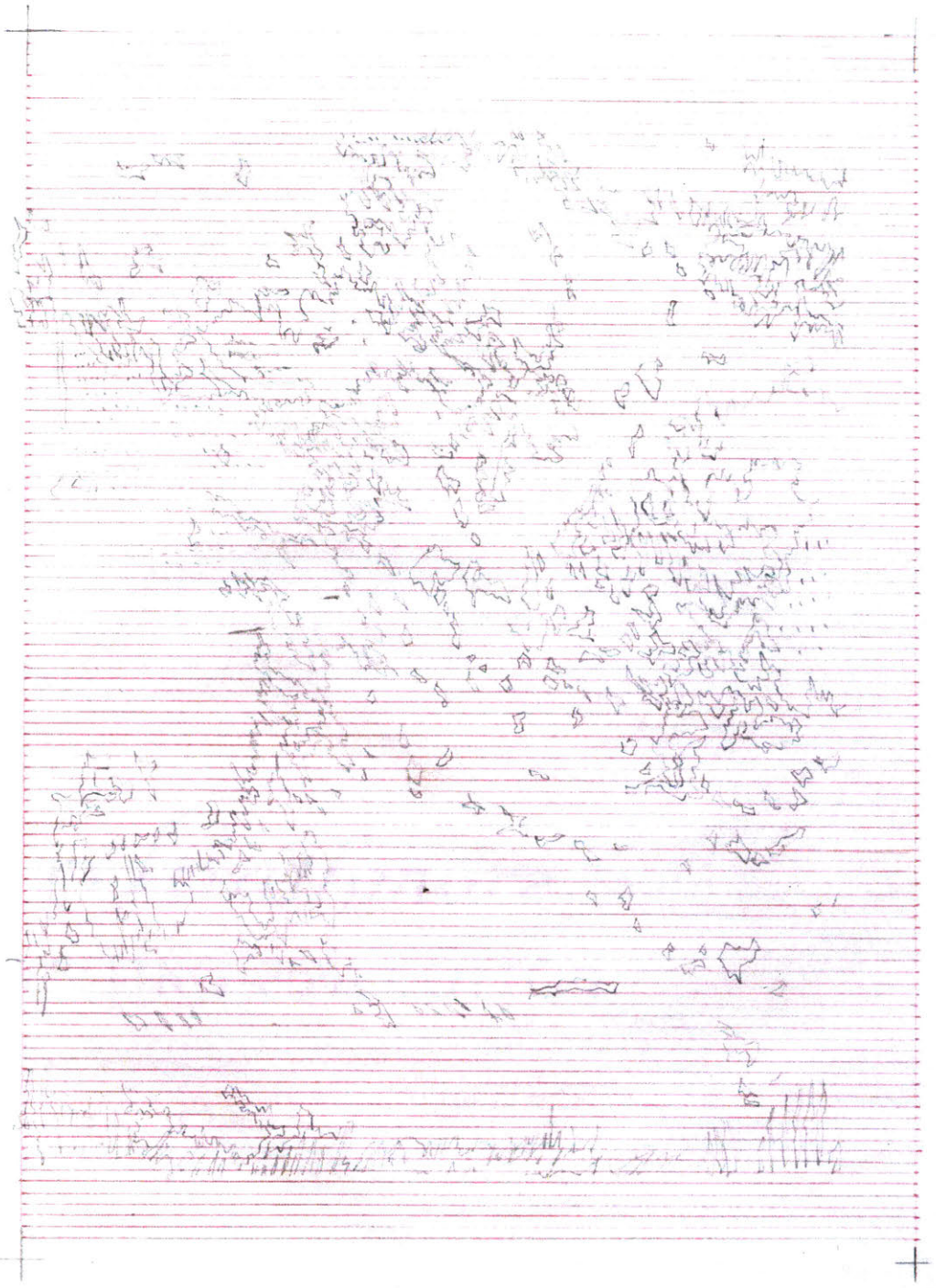

Dual Map Sketch with rules
***Observation,* Abe.**

DRAWN SAMPLES

Dual Map Sketch with sprinkles
***Observation,* Abe.**

DRAWN SAMPLES

Dual Map Sketch, streaky and fluffy
***Observation,* Abe.**

DRAWN SAMPLES

Dual Map Sketch, patchy
***Observation,* Abe.**

DRAWN SAMPLES

Dual Map Sketch, fluffy
***Observation,* Abe.**

Dual Map Sketch with texture
Abe and Cozens

Dual Map Sketch with texture
Abe and Cozens

Dual Map Sketch with texture
Abe and Cozens

Dual Map with texture
Abe and Cozens

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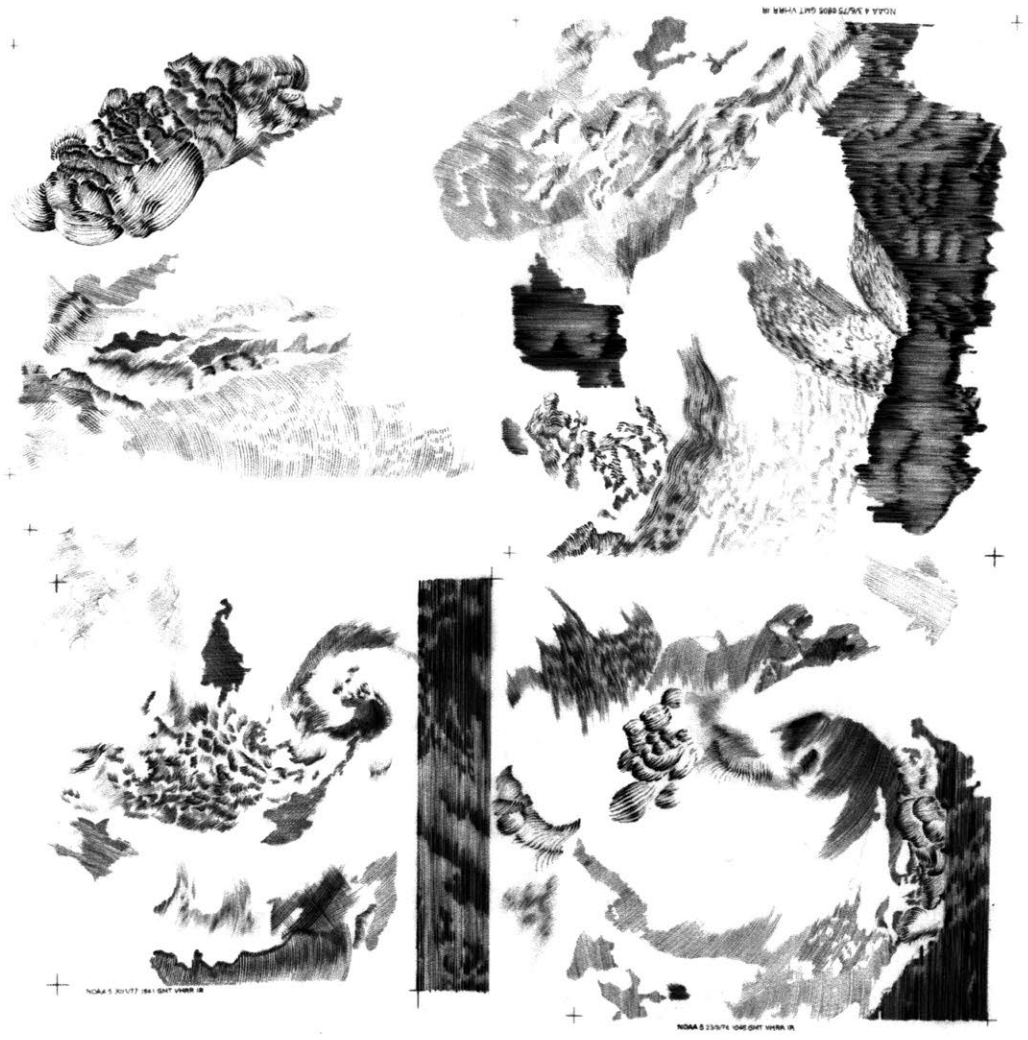
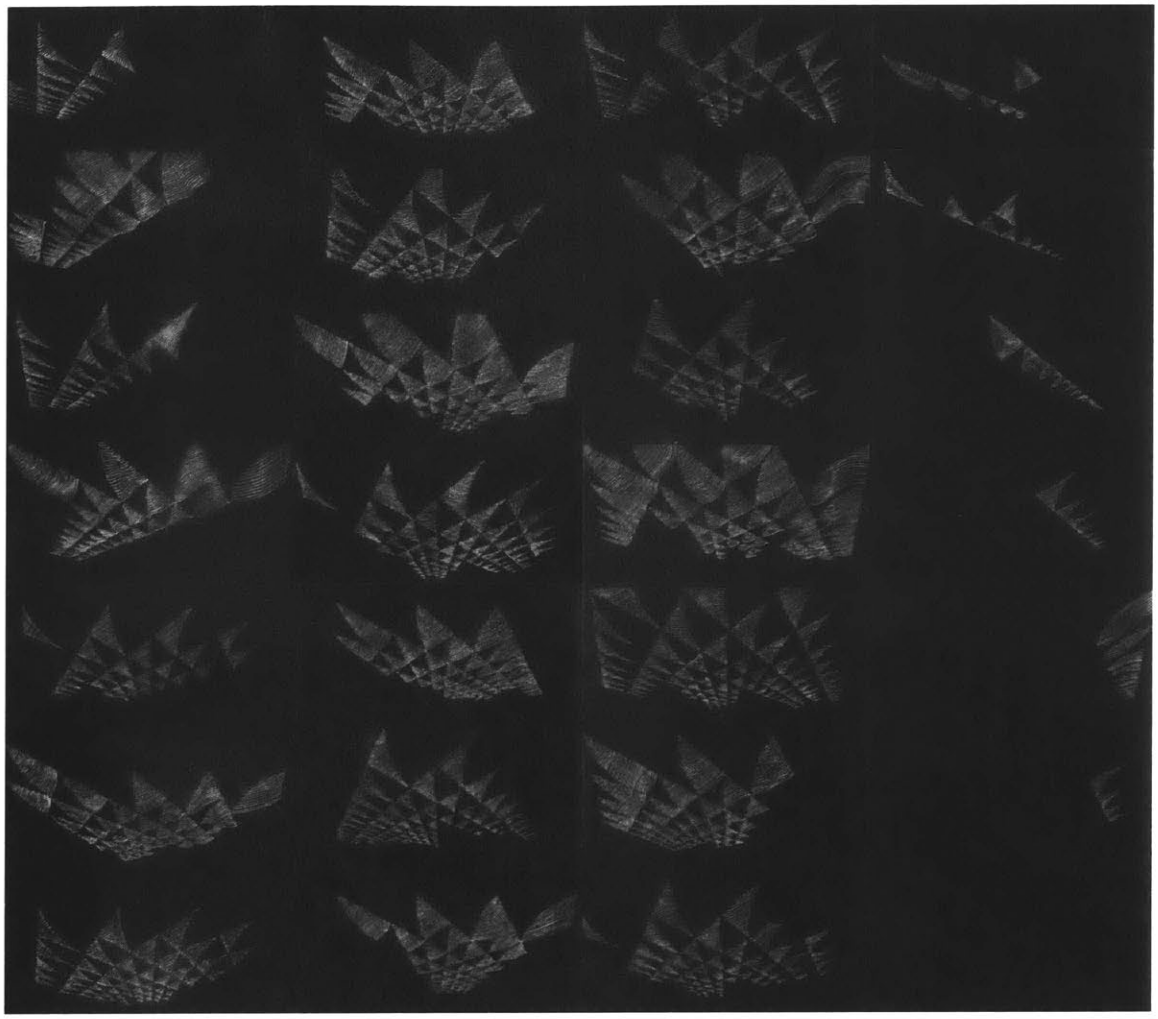


Dual Map Sketch with texture
Abe and Cozens



Receding Shapes
***Systems*, Ruskin Rectilinear 1.**

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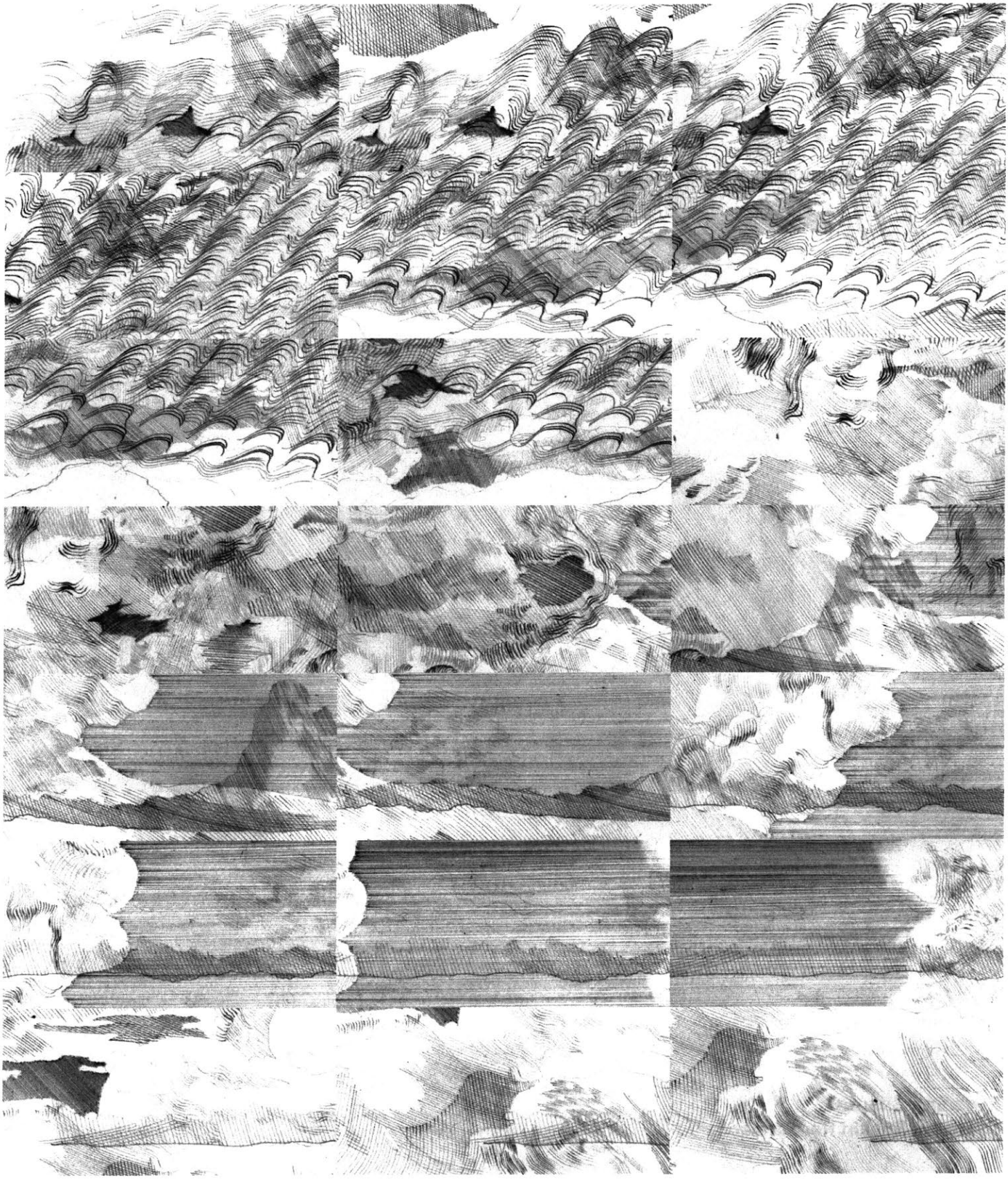
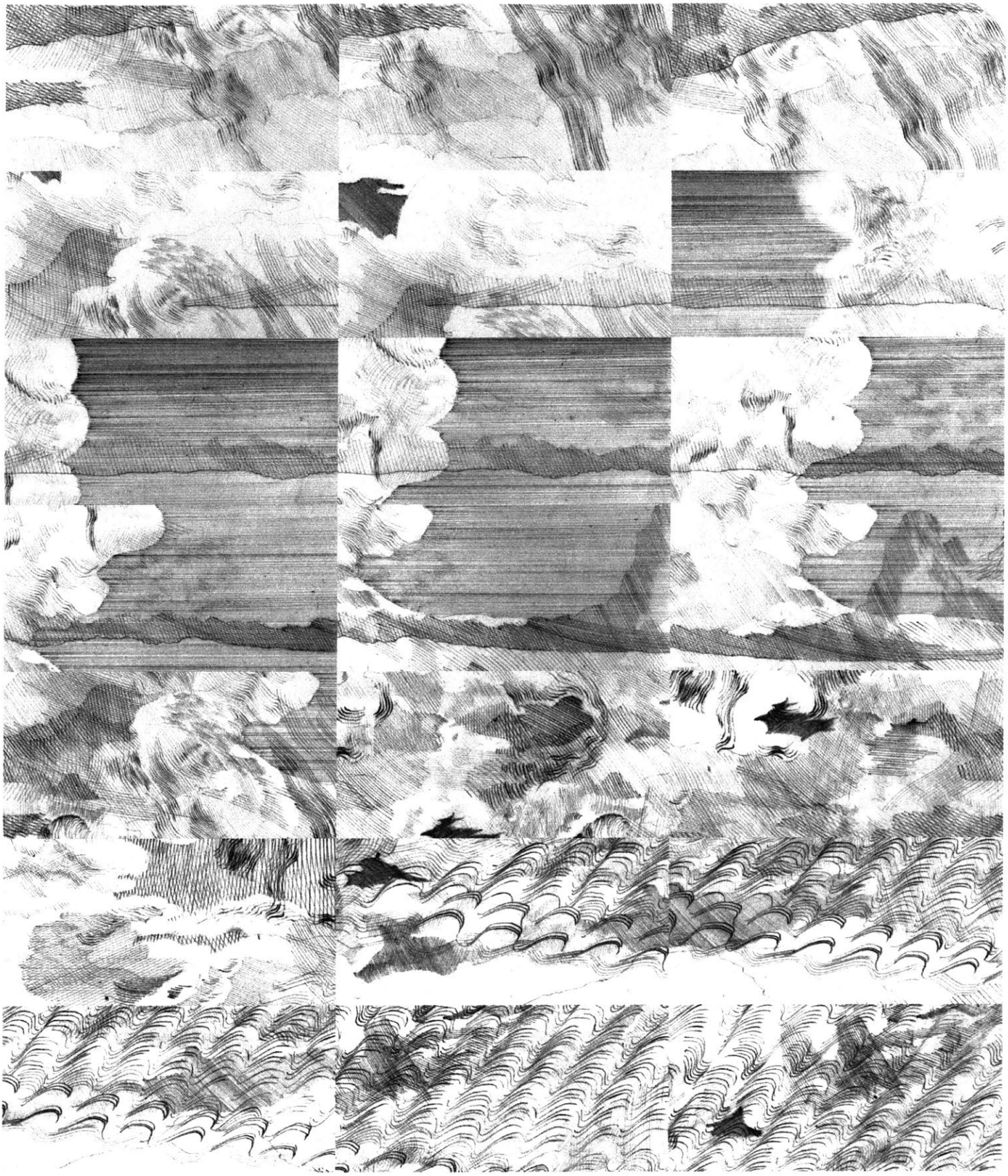


Animated Sequence
Cozens 17 + 22 + 24



Animated Sequence
Cozens 17 + 22 + 24

PERFORMED LECTURE

On May 19th 2017, the first iteration of Lecture One - *Observation, a decomposing of sky* was performed in the "Cube" at MIT Art, Culture and Technology Program.

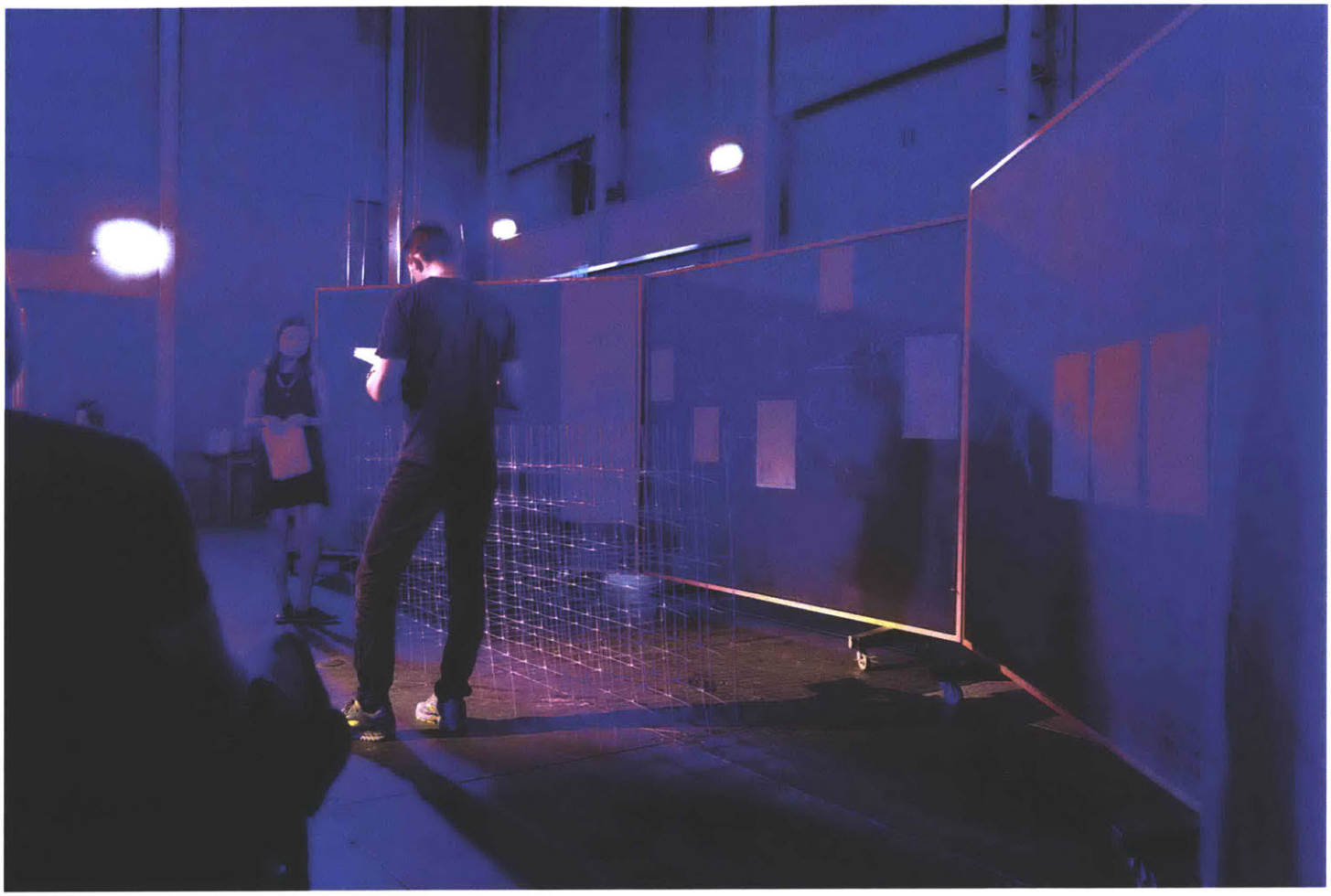
Nicholas Pacula animated FILIPPO BRUNELLESCHI and Lucy Siyao Liu animated MASANAO ABE.

Students in attendance include:
Antonio Furgiuele
Mark Goulthorpe
Mark Jarzombek
Keith Krumwiede
Jennifer Leung
David Turnbull
Gediminas Urbonas
fellow SMArchS Design colleagues,
and many other curious bodies.

PERFORMED LECTURE

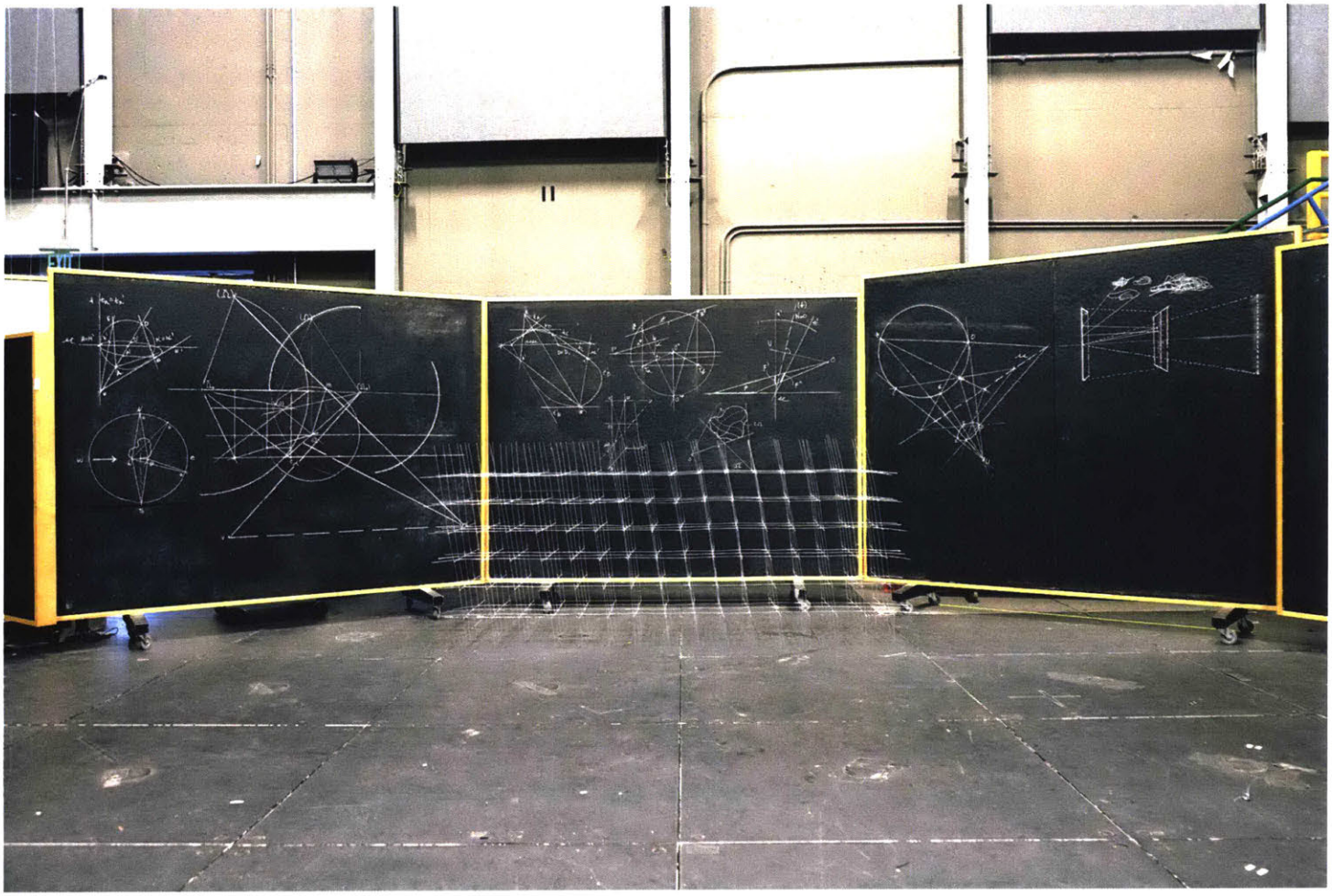
Lecture One - *Observation, a decomposing of sky*

PERFORMED LECTURE



Lecture One - *Observation, a decomposing of sky*

PERFORMED LECTURE



Lecture One - *Observation, a decomposing of sky*

SET
6cm x 6cm x 6cm unit
in a 4 x 15 lattice, 6mm members;
10 perspectival diagrams on cloud drawing.

ON THE FABRICATION OF CLOUDS

Edition 50 / 50

Advisors

Mark Goulthorpe
Associate Professor of Architecture MIT

Gediminas Urbonas
Associate Professor of Architecture MIT
Director, MIT Program in Art, Culture and Technology

Reader

Peter L. Galison, PhD
Joseph Pellegrino University Professor
Harvard University
Director, Collection of Historical Scientific Instruments

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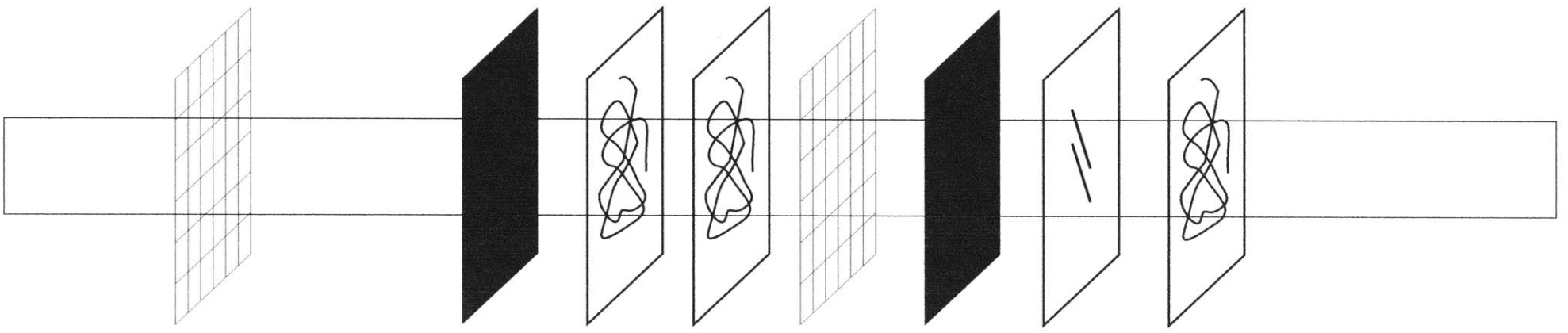
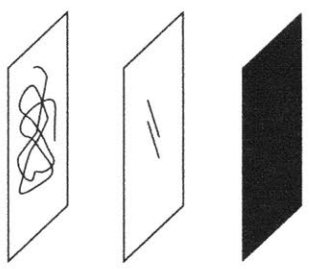
quote on facing page
Tuer, Andrew White. *The book of delightful and strange designs; being one hundred facsimile illustrations of the art of the Japanese stencil-cutter, to which the gentle reader is introduced,* 1893.

dedicated
to that
most capricious
never – to – be – understood
weathercocky
provokingly incorruptible
and
absolutely necessary person
the gentle reader





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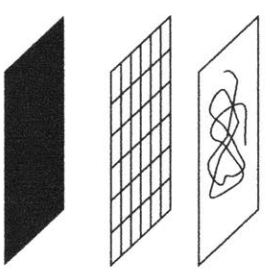

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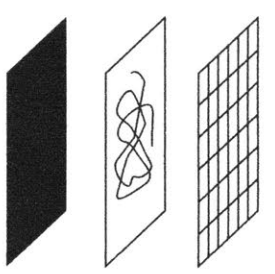

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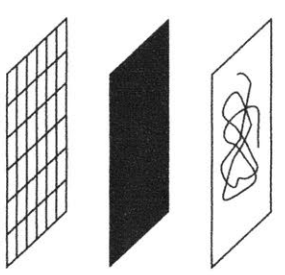

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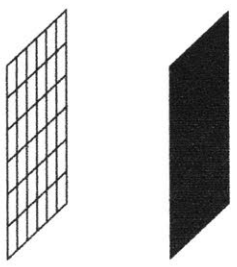

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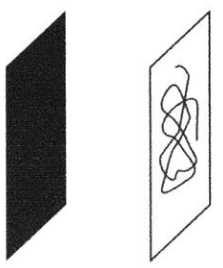

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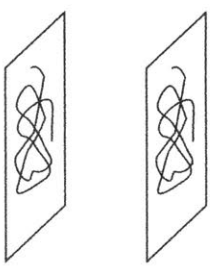

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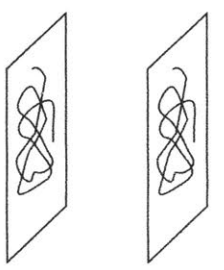

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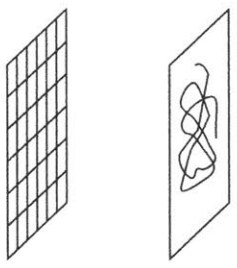

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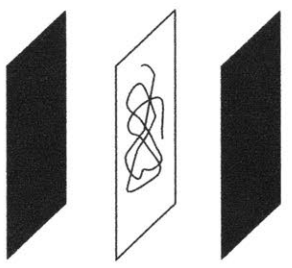


HOWARD

index as preface

"What kind of thing is a cloud?"
– Sadie Plant, Something in the Air.

This is a body of research on drawing clouds. It examines theories of drawing as produced by artists and scientists for insight into visual methods in research and experimentation. Cloud drawing is the common ground on which methodological concerns in representation may be addressed at the intersection of multiple areas of study, specifically between the means of image production in science and representational methods in design.

Analogicity

The activity of cloud depiction and the produced image are both well suited as analogies for the discretization of continuous forms. It is the process of which an image of cloud is translated into a drawing of cloud that is instrumental in establishing a design schema. Any extreme case of a representational system is a valuable subject of study – rules break and horizons fade, an inflexion point is where principles can emerge from errors.

Cloud

Cloud in contemporary discourse is rarely a cloud. Cloud is so frequently cited as a model of coherence in design, that it has become the trope shape of the 21st century. Cloud is a topological trap, a vortex for indescribable shapes. Any thing that is comprised of many parts can claim to be Cloud: network infrastructure, a quantified self, a murmuration... The cooption of the term cloud is symptomatic of a state of being. Whether it is a philosophical contemplation of uncertainty or a manual on the creation of artificial clouds in the atmosphere, one is sent off on a mess of trajectories when provided with the image of cloud. Before clouds disintegrated into a symbol for ultimate heterogeneity and dynamical systems, it too had a body with shadows and outlines. As a physical phenomenon, clouds are visible clusters of aerosols and water molecules that exist in various layers of our atmosphere. Their amorphous nature has long escaped conventional scientific protocols for the production of knowledge: clouds have no specimen, no archive, no artifacts; up until contemporary developments in atmospheric science, there was nothing for the scientists to bring back to the laboratory. This produced a situation where scientists either gathered information externally, or simulated conditions to interpret cloud phenomenon. These interpretations are directly related to their technologies at hand, whether it is drawing, photography, memory or poetry. As a diligent and aware observer in the world, I am sure you have a cloud reference to share with me. A website has been made to satisfy this desire: www.knowthiscloud.com.

Curriculum

Representation, a fundamental topic across many disciplines, is an invaluable contemporary educational medium. A curriculum is comprised of a series of methods by which objectives are determined. A curriculum is a race, a course of study, a set of goals and objectives for mastering certain ideas or skills. Propositions for polyphonic models of learning have traditionally occurred on the fringe of institutions, as "extra-mural." Recent decades, educating the masses took hold of our everyday life.

A Curriculum on the Fabrication of Clouds is structured as a series of pedagogical acts, paying homage to the rich record of learning models produced in the disciplines of art and design. *A Curriculum* acknowledges that design education is a unique model within general educational frameworks, and that design research, in addition to the advancement of theory and design methodologies, is also responsible for cultivating pedagogical models and prototypes for design education. Cultural institutions have tended towards education, as demonstrated by the surge in curation, exhibition and archival activities as alternative spaces of learning.[1] In 1963, George Nelson and Charles Eames conducted a pedagogical experiment in the Department of Fine Art at the University of Georgia, titled "A Rough Sketch for a Sample Lesson for a Hypothetical Course", in which they proposed methods for communicating course material to students in a "decompartmentalized" way.[2] They designed an immersive space for learning that integrates references and visuals across disciplines relying on various novel applications of media to deliver the information. This method is modeled as a dialectical approach. Aby Warburg famously described his Bibliothek as a Denkraum, a "thinking space" in which contents are arranged in temporary "alliances of attraction."[3] A thinking space is where various models of thinking are enacted. Similar to Warburg's library, "A Rough Sketch" allowed for "knowledge montage," where discrete artifacts from different areas of study are arranged based on intuitive associations translated spatially and temporally onto physical relations. The masses, as students, are brought in contact with the constellation of artifacts that are otherwise stuck in design spaces without atmosphere and friction. *A Curriculum* provides a series of lectures that are to be performed and consumed in no particular order. The goal is to introduce an improvisational structure to knowing, to rely on context and atmosphere to animate its contents.

Orthography of Nebulous Forms is to be performed by one individual.
Lecture One: *Observation, a decomposing of sky* is to be performed between two individuals.
Lecture Two: *Algorithms, appropriation* is to be performed by one individual.
Lecture Three: *Systems, resolving depth* is to be performed by one individual.

Digitality

In addition to drawing, designers produce specific types of representations, such as technical and digital images. However, drawing, representation and images are three distinct categories with corresponding lineages and process that should not be conflated. The virtualization of fundamental elements such as point, line, raster and edge in different tools become instrumental in determining what an image is. Any exercise in determining criteria for a digital image involves the evaluation of a space - time relationship between parts and whole. Whether it is a point enabled by time to produce a line, or the addressability of pixels within a grid, the basis for a digital image is centered on the temporal sequencing of information within material limitations of technology. In terms of a computer image, time is a medium through which an image emerges from digitalization processes and approaches reality. Digital images are artifacts revealing how tools deal with time, and in turn, how tools affect the readability, fallibility and the capacity for an image to deceive in real time. Tool is to digitality what the style of linear perspective is to vision: tools are means to enable a structure for digitality, which exists in an environment otherwise invisible to a visual regime. A digital image is produced through a combination of tooling and temporal sequencing of matter.

Drawing

"Drawing, it seems, is here neither representation nor remembrance, but fabrication and invention."[4] Drawing is an activity with ambiguous implications across different disciplines. Any effort to pin down a universal understanding of drawing, as both process and product, has been no small feat.[5] A common issue that plagues productive studies of drawing is the lack of contextual information to relate drawing methods to concerns of how drawings work in design studies. Patrick Maynard, philosopher of 'all kinds of drawings,' outlined in Drawing Distinctions the two modern technological questions that pertain to drawing: one, the extent to which drawings

are used in making new kinds of things, and two, new kinds of drawings.[6] Design studies are concerned with the first category, the ways in which drawing participates in allowing various tools to produce designs. In this case, drawings are functioning in service to tools and methods. Drawing, is not an autonomous practice, and relies on technologies of production to fulfill a function. Sometimes, drawings may be created solely for the purpose of communicating between tools – the value of its existence is in its value for production. The category "new kinds of drawings" in design discourse has been almost synonymous to new kinds of tools – an assumption that new tooling ontologies will naturally result in new ways to draw. This is only partially true. While advancements in devices do introduce novel ways to draw, the resultant drawn artifact does not always establish a new species of drawing. New kinds of drawings entail forming new kinds of drawing elements and organizations, novel techniques that elicit qualities of representation distinct from existing moves. The drawings produced in this work are considered working objects. A working object is a communal representation of a sector of nature under investigation, used to standardize scientific objects of inquiry.[7] Drawing as art is a tendency. Deanna Petherbridge considers drawing as "autonomous practice," in which only the "authorial artist" can define drawing in its liminal state.[8] Since no drawing practice is deprived of a space and a context, the acknowledgement of the process is crucial for it functioning as a drawing. This is not an argument for "make drawing a drawing again" or a return to nostalgic practices. Even for Leonardo da Vinci, homo pictor and homo faber have become dialectically intertwined: picturing and making constitute the fabrication of effects.[9] Da Vinci's exploratory drawings were considered an emblem of transition from a Platonic tradition of drawing for mimesis to "drawing as instrument of thinking and as an essential activity in research and invention."

Incursive method

An incursion is an invasion or an attack usually into a place or a territory, a momentarily taking over of, a raid. Juxtaposition, disjunction, estrangement...are all methods through which artists, designers and theorists have deployed to gain 'new' content from existing forms. An incursive method is interplay between organizational systems and improvisational acts, a cooption of an existing norm to produce other effects. It is research done laterally, working in knots. Svetlana Boym coined the term "off-modern" as a "non-linear conception of cultural evolution."[10] This cooption of a feature, when a trait evolves to serve one particular function and subsequently serves another, is also known as "exaptation" in biology. "In this context of conflicting and intertwined pluralities, the prefix 'post' is passé." Post-, anti-, neo-, trans-, sub-, inter-...an inability to escape an illusion of linear progress plagues our methods.

(Notes)

1 Examples of exhibitions that have taken on pedagogical motivations include, *A Curriculum* at HKW, *SALTWATER: a Theory of Thought Forms* and *Radical Pedagogies*.

2 http://www.eamesoffice.com/the-work/sample-lesson-for-a-hypothetical-course/

3 Vesters, "A Thought Never Unfolds in One Straight Line: On the Exhibition as Thinking Space and its Sociopolitical Agency." Stedelijk Studies.

4 De Warren, "Ad Infinitum: Boredom and the Play of Imagination." *Infinite Possibilities*. 2004.

5 *Writing on Drawing*. 2012.

6 Maynard, *Drawing Distinctions*. 2005.

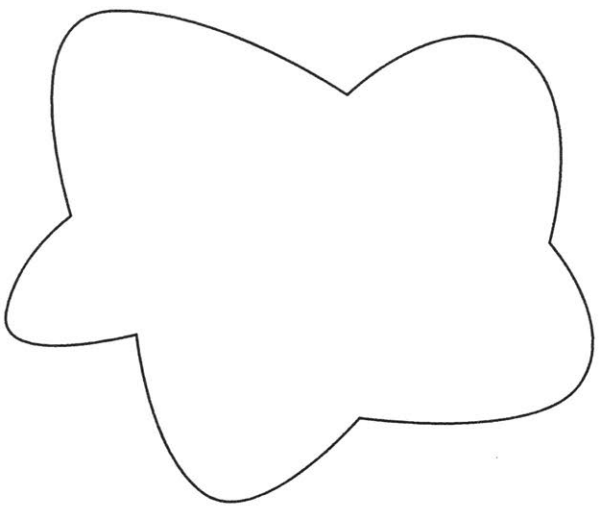
7 Daston and Galison, *Objectivity*, 19.

8 Petherbridge, "Nailing the Liminal: The Difficulties of Defining Drawing." *Writing on Drawing*, 2012.

9 *Writing on Drawing*. 2012.

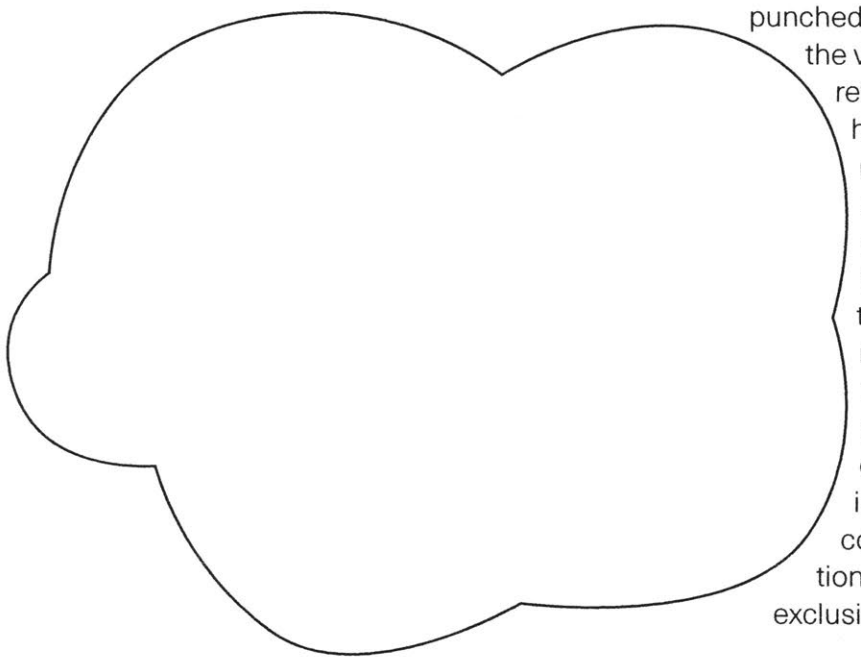
10 Boym, *The Off-Modern Manifesto*. 2010.

orthography of nebulous forms: drawing, rules for drawing and drawing poorly in early cloud science



"When it comes to clouds, every object-description is a self-description."[1]

The dive into clouds begins with a demonstration mistaken for an experiment. Filippo Brunelleschi is rumored to have painted on a small square panel the perspective view of the Baptistery of San Giovanni in Florence as viewed from inside the central doorway of the Cathedral of Santa Maria del Fiore.[2] By viewing through a small hole punched in the panel corresponding to the vanishing point, one can verify the reflection of the painting on a mirror held before it, with the scene of the real Baptistery. In the diagram of a reconstruction of the 'experiment,' clouds are drawn as doubly reflecting off of the mirror and then off of the painting itself. The cloud dually reflected, first in the mirror and then in the silver of Brunelleschi's painting, is a slippage of an ideal construct. The cloud discovered is not produced from the drawing construction; rather it is a verification of the limitations in a structure of exclusion.[3]



To draw clouds is inherently a paradoxical act; yet artists and scientists have drawn skies for millennia, setting themselves up for failure as soon as they made a solid mark. What did cloud elucidate that no other subject could replace? Nephology, the science of clouds and its experimental methodologies, is a model to design exact measures for inexact subjects. As writer Marcel Beyer states aptly, if you devote yourself to clouds and their study, you're lost, unless one changes perspective and regards nephology itself as the laboratory - as one of the 19th century's great laboratories of poetic and artistic theory.[4] Changing perspective not only implies revisiting cloud studies to extrapolate relationships between art and a science of optics, but also setting up drawing schemes for new kinds of vision to occur.

Drawing and writing share the term 'orthography.' Ortho – meaning the right way or the right angle, and graphia – to draw, inscribe or write with a point. In writing, it refers to a set of conventions for structuring a language, the symbols and rules for organizing the visual codes of which language is composed, literally "correct writing," or similarly, a correct patterning of symbols. Whereas in drawing, orthography is usually used in conjunction with 'projection.' Orthographic projection is a set of graphic conventions for mediating between three-dimensional shape and two-dimensional representations, and vice versa. Drawing to record clouds conflates the orthographies in drawing and writing. Luke Howard not only rationalized the skies by creating a nomenclature for clouds, he also designed a new orthography for cloud recognition.[5]

"No sooner did nephologists attempt to solve the fundamental problem of registering clouds armed with a new device than they were forced to reflect on the characteristics of this new medium, on their own perspective and methodology, and on the subject of the research and the phenomenon to be registered – the cloud as 'subject.' From the very start, every stage of nephology has been accompanied by reflections on the activity of self; indeed, at times the study of clouds seems to be comprised first and foremost of self-examination."[6]

An experimental framework in depicting cloud is an exercise in designing a technical schema for representing and imaging the world. The documentation and subsequent analysis of clouds are thus the experimenters' exercises in devising drawing methods, which tend to fabricate clouds rather than record. They were master cloud modelers, literally constructing systems out of thin air. Drawing a cloud is the extreme case of making a free shape conform to a systematic armature; it is design drawing "at full stretch."[7] Cloud drawings are working objects through which conventions and processes of drawing across several disciplines may be discussed.

In the following lectures, we examine three types of drawing through the methods of cloud physicist Masanao Abe, landscape painter Alexander Cozens and artist John Constable. Abe drew clouds, he used the technique of dual mapping and stereographic projection to analyze clouds in the photographs of his cinematographic studies, a process derived from observation; Cozens developed rules for drawing clouds, schemas for inventing new textural combinations relying strictly on graphical rules; and Constable appropriated the rules devised by Cozens to paint new clouds, which according to a scientist, violates the contract between an artist's role in service to natural science, which is to depict real clouds. Constable's paintings were considered "bad" cloud drawing.

On August 4, 1926, Japanese physicist Masanao Abe (1891 – 1966) documented a bizarre cloud over Mt.Fuji with a time-lapse camera that recorded an image every ten seconds. Abe arrived at the height and heels of cloud studies. Named fifteenth head of an illustrious samurai family, ironically, Abe devoted himself to research on the least precise thing the world had to offer. His bourgeois upbringing provided him access to new technologies in his youth, such as the first screenings of cinematography in Japan. Abe became increasingly fascinated by the potentials of the 'moving image.' Applying this passion into his research of clouds, he invented various devices to record meteorological phenomena. In 1927, he founded the Abe Cloud Air Current Research Observatory on the heights of Gotemba, at the foot of Mount Fuji. Over the course of the next twenty years, until the beginning of WWII, Abe created a significant archive of cloud images and models studying mountain clouds and air currents, by frequently hybridizing techniques of documentation and constructing his own instruments for analysis. The space-time grid would prove to be instrumental in Abe's analysis work later in his career. He relied mainly on the budding techniques of cinematography to record cloud movement in consecutive shots. Shown here is a spread from his field study sketchbook with the framework he designed to analyze the cloud housed within the photograph. He would trace the edge of the cloud with a line and replace tonal contrast with notations and codes. Each page was also accompanied by data recorded on site, such as wind speed, pressure, temperature, etc. Although later in his work, he adopted labeling and line conventions from the International Cloud Atlas, he was the only cloud physicist to use arrows in his drawings to indicate projected vectors.

There were also several instances in which he did not record anything; not that there was no content in the photograph, but because there was no observation made. Herbert Simon quotes Oscar Wilde in Sciences of the Artificial on how there were no fogs on the River Thames until Turner, by painting them, revealed them to the residents of London. In Abe's case, there is no cloud if it's not drawn.

He was considered the 'Count of Clouds' and was dexterous moving between his technologies. He constructed an experimental model to stereoscopically align photographs he had taken with cameras next to each other. Abe was quick to adopt new techniques into his work, and was often criticized for the taboo of optimizing instruments while performing experiments. For example, he was one of the first scientists to place an entire landscape inside a wind tunnel. He combined the fields of fluid dynamics, aerodynamics and cloud science by placing a model of Mt. Fuji inside a wind tunnel to simulate cloud movement, and then analyzed the photographs from the simulation in parallel with photographs of real conditions. Because of his unconventional approach, his early work such as the Cinematographic Studies of Rotary Motion of a Cloud Mass near Mt. Fuji produced in 1927 were not recognized by the Japanese Meteorological Society as legitimate scientific research until his second submission a few years later. He is a designer of experiments, but also an experimental designer: his analytic and imaginative labors are fused and amplified with his practice as photographer, draftsman and modeler. His recognition in the field of climate sciences marks the significance of the production of images in contributing to scientific knowledge. However, Abe's contribution to cloud science never had the chance to gain wide recognition, as the entire field of cloud science was quickly forgotten. Atmospheric science replaced nephology after WWII and cloud studies were considered, struck with a similar fate as physiognomy, as a pseudoscience.[8]

Alexander Cozens is a landscape painter who defied the objectives of landscape painting. In his seminal work, A New Method of Assisting the Invention in Drawing Original Compositions of Landscape, he proliferated the method of "blotting," in which he defined as "the production of chance with a small degree of design."[9] Cozens methods align with a rich history of emergence as produced by artists. His desire to produce landscapes was neither to imitate old masters, nor to represent a unique reality. He sought a type of landscape that was completely out of the domains of current style: an "original landscape" that emerges, rather than merely exists.[6] Cozens even states that he is creating 'artificial representations of landscape' and as he simulates a space with rules, he allows the space to invent images of new landscape. He rendered a wholly unrecognizable landscape and irreducible in form. This instance of post-perspective exploration of the drawing surface produced a new kind of drawing – a computational drawing. In New Methods, Cozens included twenty engraved plates of invented cloud compositions algorithms under each figure. Rather than capturing the cloud by drawing in situ, Cozens developed a system of cloud depiction that suspended drawing from representation. Maynard identified spatial issues in drawing in two main categories: spatial properties produced by drafter and spatial properties of subject matter.[10] Cozens used spatial properties produced by his drawing methods to invite an image of spatial properties of cloud into the landscape. His algorithms explore depth through texture.

A background is a key component in basic compositions – is it also a necessary field in which a foreground can emerge. Clouds are put to work in compositions to allow the sky to be seen.[11] The process of filtering primary information of a foreground from the 'noisy' information of the background creates an image. Let us revisit 300-year-old algorithms for cloud depiction to explore the value of noisy backgrounds.

Engraving is a technology created for the purposes of mass reproduction. The replication of paintings became a ubiquitous technique deployed by artists to introduce images into the circulation of knowledge and for aesthetic education. Incidentally, in this process of modernization of tools to standardize representations, clouds being the background with the fewest definitions, became an experimental space for expressive facture that etching artists exploited as value. The artist's facture is the desired function or value of such a copy. Variability and uniqueness in technique became capital and culture.

Before we get to the truly "bad" cloud drawer, I'll interrupt myself with a note about the algorists. In 1995, computer artists Roman Verostko and Jean-Pierre Hébert suggested that the descriptive term "algorist" should be applied to anyone who creates artworks using an algorithm. They expressed the conditions in the Algorist Manifesto:

```
if (creation && object of art && algorithm &&
one's own algorithm) {
        include * an algorist *
}
elseif (!creation || !object of art || !algorithm ||
!one's own algorithm) {
        exclude * not an algorist *
}
```

Given the manifesto was written in pseudo-code, the term algorist was meant to be inclusive. As "object of art" can be interpreted in a variety of forms, and "algorist" can be applied to any one who uses rules to make structures, "be she a painter, a sculptor, a weaver, a composer, an actor or an architect." Allow me to highlight the immense creativity demanded now to fulfill the last requirement, "one's own algorithm", because the algorists' project here is not only to work algorithmically, but also to not sacrifice intuition in algorithmic work. Let's just consider how to not sacrifice perception in algorithmic work. It also states nowhere that algorithmic work is dependent on the computer; the openness to medium allows algorithms be our common ground. Algorists existed long before the algorist manifesto. Colette took on the project to depict computational grass by first producing hand drawn grass, and then Charles studied the algorithmic structures in the drawing to produce rules to draw computer

grass. The reverse engineering of a drawing not only revealed how to program grass on a computer, but also introduced a common ground to understand the artist's process of observing and drawing. It is taboo to post-rationalize, but I think Alexander Cozens was an algorist.

John Constable, who would later coin his method as 'skying' in 1821, appropriates schemas for skyscapes developed by Cozens in 1785. Some of his compositions were based on completely fictional depictions of clouds. Artist Gerhard Lang photographs the sky from Constable's own doorstep, to find out whether "Constable's clouds are still passing." If he knew the truth of Constable's skies, he would not be looking for clouds in the sky, or even in reality.[12]

Now I will clarify what it means to draw poorly. William Clement Ley, a meteorologist and inspector for the British Meteorological Office, gave a series of lectures on "Clouds and Weather Signs," in which he outlined many problems within the field of nephology at the time, but provided few solutions. Most notable of his complaints, was his relationship with artists; he acknowledged their shared interest in nephological research but condemned artists for not fulfilling their base responsibilities to be the draftsmen of science. According to Ley, there are three ways an artist might draw "bad" clouds:

1. guided by "the eye of the public, to whom a cloud is a camel, weasel, or whale shaped mist, and nothing more", so a the person has no observational skill, their eye is not trained;
2. no skill in depiction or precision (the person is knowledgeable of cloud science, but their hand is not trained);
3. painters who pursue cloud studies with "an eye of a natural scientist, and who do not lack art' but 'when facing the canvas are clearly obsessed with painting bad clouds'; they do not 'see wrongly, but they depict 'wrongly, and that will full intent' (the person is well trained but have no interest in using these skills to contribute to scientific observation or recording. Instead, they draw and paint sublime cloudscapes that the scientists do not recognize at all.)

It is obvious that Constable was not a bad painter: he was one of the greatest masters in Romanticism painting in early 19th century. But he was precisely the good kind of "bad" cloud drawer: adopting Cozen's rules to generate for himself new "clouds" regardless of reality of cloud depictions. In design representation, it is easy to default into the common dichotomy between digital and analog techniques by equating the tool to technology. As demonstrated in Cozen's case, his method is combinatoric, hence discrete. Deleuze suggests in Francis Bacon: Logic of Sensation, that digitality finds its origins in our [hand] digits; my mother is no Rosalind Krauss but even she makes a good point about how our five digits are not the same length, so how can we agree on a homogenous base unit? Is discretization enough to define digitality? It is also easy to assume working algorithmically, is working creatively. My investigation is situated at the conflation between digital translations of analog draw and analog interventions into digital draw. By selecting cloud as the subject of investigation, I deprive myself of any stock moves: be it algorithmically, computationally, analogically. There is no referent object, because it is an investigation into method.

v CLOUDS OF INVERSION 69

The amount of slant may be represented by AB, the distance of the head of the cloud from the tail. The amount of slant visible to an observer may be represented by the angle AOB, and it will be seen from the figure that this varies according to the observer's position.

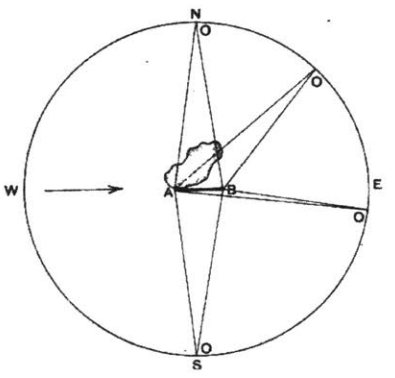


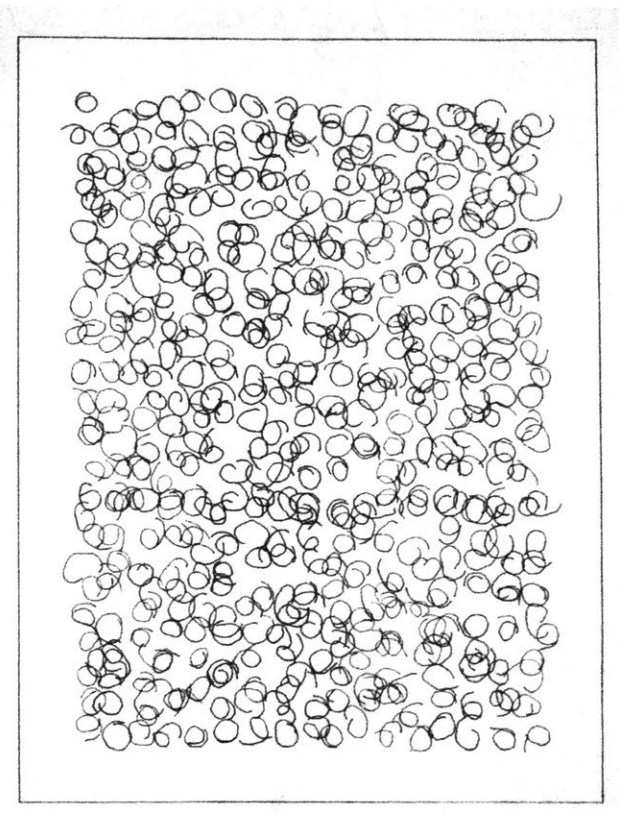
Fig. 4.—Slant of Cumulo-rudimentum.

In nature, for reasons which will be seen in later pages, increase of velocity as we ascend in the atmosphere is seldom unaccompanied with some change of direction in the currents of air experienced; and when the summits of *Cumulo-rudimentum* have a lateral deflection due to change in the direction of moving air, the appearance shown in Fig. 4 is more or less modified. In such cases we have in the higher latitudes of the globe a valuable interpretation and a useful means of forecasting weather. For example,

William Clement Ley, *Cloudland*, 1894.

set camera 1, 22 degrees at NO
set camera 2, 22 degrees at NOE

Colette and Jeff Bangert
Landscape Coils, 1967



(Notes)

1 Beyer, *Cloud Studies*, 124.

2 Damisch, *A Theory of /Cloud/*, 121. Antonio Manetti's biography of Brunelleschi being the only record of existence of such panels.

3 Damisch, *A Theory of /Cloud/*.

4 Völter, *Cloud Studies*.

5 Howard, *On the Modification of Clouds*. 1802.

6 Beyer, *Cloud Studies*, 125.

7 "...what else, in other words, but things already defined and made according to the regulative lines and planes of classical geometry? The answer is everything and nothing. Nothing else can be projected by Alberti's construction, unless previously reduced to a reticulated armature. But everything else can be sketched in the boxes thus provided. Hubert Damisch asks us to consider clouds, an extreme case." Evans, *The Projective Cast*, 133.

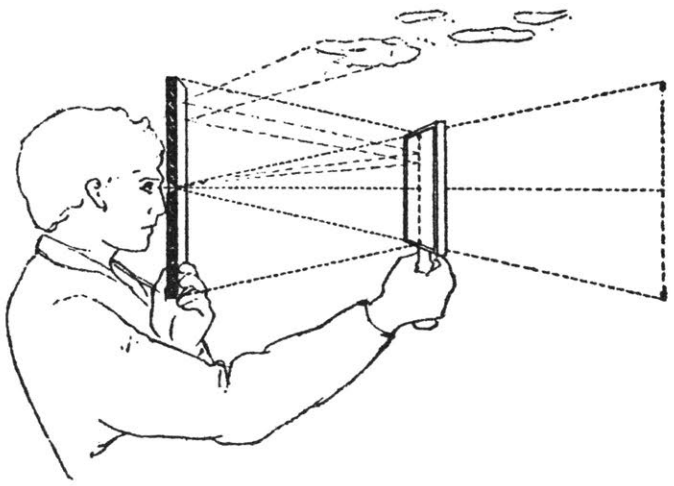
8 Daston. *Cloud Physiognomy: Describing the Indescribable*.

9 Cozens, *A New Method of Assisting the Invention in Drawing Original Compositions of Landscape*, 1786.

10 Maynard, *Drawing Distinctions*. 2005.

11 "...or rather, children's drawings of the sky, in which clouds are put to work, employed to express the presence of the sky. They may be obscure and obscuring things, but, in such pictures, clouds let the sky be seen." Sadie Plant, "Something in the Air." *The Movement of Clouds*. 2016.

12 Plant, "Something in the Air." 2016.



A reconstruction of Brunelleschi's first perspectival experiment. Alessandro Parronchi, *La dolce prospettiva.*

"To perceive a visual image implies the beholder's participation in a process of organization. The experience of an image is thus a creative act of integration...its essential characteristic is that by plastic power an experience is formed into an organic whole. Here is a basic discipline of forming, that is, thinking in terms of structure, a discipline of upmost important in the chaos of our formless world. Plastic arts, the optimum forms of the language of vision, are, therefore, an invaluable educational medium."

Gyorgy Kepes, *Language of Vision*, 1976

This lecture is concerned with what may strike some as an uncharacteristically impractical subject, with equally impractical applications.[1] I am speaking of clouds, and in particular, the tension between observational techniques and the recording of clouds. Here, a scene of an impossible conversation between 15th century architect and Renaissance engineer Filippo Brunelleschi and 20th century cloud physicist Masanao Abe, staged to present to you a conflict in imaging methodologies in scientific and artistic experimentation. We enter the scene with Brunelleschi vehemently convincing Abe that the perspectival method is sufficient to uphold all the geometries we need in representation.

FILIPPO BRUNELLESCHI isn't overtly insecure, but you wouldn't want to challenge his principles. **MASANAO ABE** isn't especially cavalier, but his tendencies are rather unorthodox. A classroom, some chairs. Architect's drawing board and some cameras, perhaps.

BRUNELLESCHI (Frantically drawing diagrams on the chalkboard. In a mass of figures, one can spot the diagram of Brunelleschi's first perspectival experiment. Measuring, figuring things out.)

ABE No matter how precise your lines, they are not going to accommodate the clouds –

BRUNELLESCHI (Stops drawing. Turns around.)

Abe, my dear friend. Do you not see that these lines match directly?

(Points at drawing.)

I have got to be the expert of this by now. Although, I would like to remind you, that you are the scientist here.

ABE Yes, and I, the scientist, is telling you that clouds do not fit into your rules. You cannot simply apply the perspectival grid onto a cloud and call it a system for cloud depiction. This technique is not calibrated for measurement or even proper observation; your painting lining up with an occurrence in reality was merely a coincidence.

BRUNELLESCHI Observation in the 15th century was a bigger endeavor perhaps, without these devices to help me...

(Gazes as cameras.)

But you cannot deny that my experiment was revolutionary for the rationalization of observation. Shoving the world into a few points and lines, as crude as that may sound, completely shifted conceptions of space and depth. This drawing system even provided the viewing subject a body, a Renaissance body, with an awareness of place and distance. What are a few clouds in comparison to the achievements of this system otherwise?

ABE Indeed, it is a powerful tool, yet you admit that it cannot accommodate clouds. Which means I cannot use it. Your depiction of the sky is not depiction at all!

BRUNELLESCHI But my experiment –

ABE It was not an experiment.

BRUNELLESCHI (Slighted.)

Let me explain to you, Count of Clouds, how I set up the experiment, once again. I draw a horizon line, I place a vanishing point on the horizon line, I project a series of lines towards the vanishing point that produces the illusion of ground, I paint my view of the baptistery of San Giovanni according to these angles and lines, I hold up my painting of the baptistery of San Giovanni facing away from me, and look through the hole in the painting corresponding to the vanishing point into a mirror, allowing me to see the reflection of the painting, and by aligning my view with the baptistery, I can verify that my painting can be dual mapped onto the real view. All the elements matched perfectly, even the clouds.

ABE So how did you paint the clouds?

BRUNELLESCHI I didn't! I painted the sky with darkened silver, so the natural air, sky and clouds could be mirrored exactly like a real view.

ABE Exactly. It was a demonstration. You made no effort in devising rules for drawing or painting clouds. There was only observation and no recording, how can you call that an experiment in cloud depiction?

BRUNELLESCHI But even Vasari agreed that this system of depiction was an "ingenious procedure" that would define all space![2] The silver on the painting is to acknowledge the reality of the clouds. Demonstration, experiment or what have you, the silver allows for the true nature of clouds to exist within my system, without reducing the subject to definitions. It is cloud, no matter shape or form.

ABE Even clouds require definition. They are the extreme case in a representational system. Drawing the cloud from my photographs is crucial to my analysis of their behavior. Allowing the chaos of natural clouds to exist in your painting is avoiding a challenge, and also forgoing an opportunity to test the capacity of your drawing system to become truly inclusive of everything.

BRUNELLESCHI Then may you please elaborate on the correct way to experiment with clouds? These artifacts you concocted in your wind tunnel –

(Points at photographs from the wind tunnel.)

These are merely demonstrations, as well? You put a landscape into a wind tunnel. No one has ever tried to do that.[3] You would consider the clouds in the simulation just as legitimate, if not more valuable as evidence than the clouds in the sky. I can barely differentiate between the two.

ABE If we were speaking of simulations, I would consider your demonstration also an exercise in virtuality. I'm not an expert on clouds in general; I have no interest in claiming the skies as Luke Howard did. I do not study every cloud; I do not even photograph every cloud. The objects of my experiment, to be precise, are the photographs of the clouds rather than the clouds themselves. Stereoscopic recording is a key method my research. While I realized that a standard stereo camera was not enough to deal with the distance between my observation station and Mount Fuji, as the gap between the lenses were too small and could produce no effect of spatial perspective, I constructed two observation stations 500 meters apart from each other to record at the same time. But when it came to constructing a stereographic image, 500m had to translate back into the distance between two eyes...the observer would then become a 14,500m tall giant, or Mount Fuji would be a 50cm high hill.[4] The scaled stereoscopic grating system is a three-dimensional observation tool that I designed specifically for cloud observation at the distance, height and angle as set up by my experiment. It is an instrument borne out of the specifics of a context, rather than an application of a standardized tool. This is where our worlds conflate.

BRUNELLESCHI You're forced to depict in perspective.

ABE Yes, I was forced into your world of shards that enabled the creation of wondrous things, such as checkered floors. No wonder you were so popular.

BRUNELLESCHI But you agree with my resistance to standardizing cloud depiction. When perception becomes habitual, it becomes automatic.[5] My method in rationalizing space is in support of truth to species in observation. This art of measuring is not caricaturizing the specificities important to experimentation, rather it is allowing things, not pre-defined objects, to coexist in an image. You wanted to preserve as many natural qualities of clouds as possible in your tool, so did I.[6] Clouds served their simple purpose of providing me a realistic background, I am satisfied with my results.

ABE Background is everything. Recording is the process of extracting information from the noise of the surrounding world.

BRUNELLESCHI I would probably regret mentioning him, but Leon Battista Alberti wrote the first treatise between art and optical science in 1435, but I was practicing codified perspective methods already in my work. The sky is not there until clouds are added, the clouds worked to reveal the sky. Honestly, if any other object could serve the purpose of signification, I would use it. You and your clouds are killing me, Abe. Why do you care? What is it about cloud that is worth dismantling my world –

(Gestures towards diagrams.)

ABE Perhaps a comparison can be drawn between my obsessions and Alfred Stieglitz creating Equivalent, his series of sky photographs produced just a few years before I began my recordings. I admit: I am guilty of succumbing to the mechanization of vision enabled by cinematography. My first experience with 'moving photographs' left me wondering about three things: the duration of an image, the material of the image, scratches on film that initially seemed like rain, and the flickering of consecutive frames. It is this passion for novel qualities of vision produced through cinema that really propelled me into the study of clouds. I was interested in using film to study natural phenomena – I think it would be closer to the truth to say that for many years, I'd been more fascinated by cinema than by clouds.[7] The images produced in my pursuit of clouds and their ability to recreate the reality of a world became the true subjects of my science... In the end, Stieglitz was only using cloud as a prop to experiment with the qualities of the photographic image.

BRUNELLESCHI Then what do you love, you extraordinary stranger...[8] You accuse me of being too enamored with converging lines?

(Notes)

1 Opening statement. Luke Howard, *On the Modification of Clouds*. 1802.

2 Damisch, *A Theory of /Cloud/*, 122.

3 Völter, *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe*. 2016.

4 "Strictly speaking, this three-dimensional view is an artificial effect that does not correspond to what one perceives with the naked eye. If the 500m distance between the cameras were to equate to the distance between the eyes, then the observer would be a 14,500m tall giant, or, using a different calculation, Fuji would be a 0.5m high hill at a distance of 2.5m." Völter, *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe*. 2016.

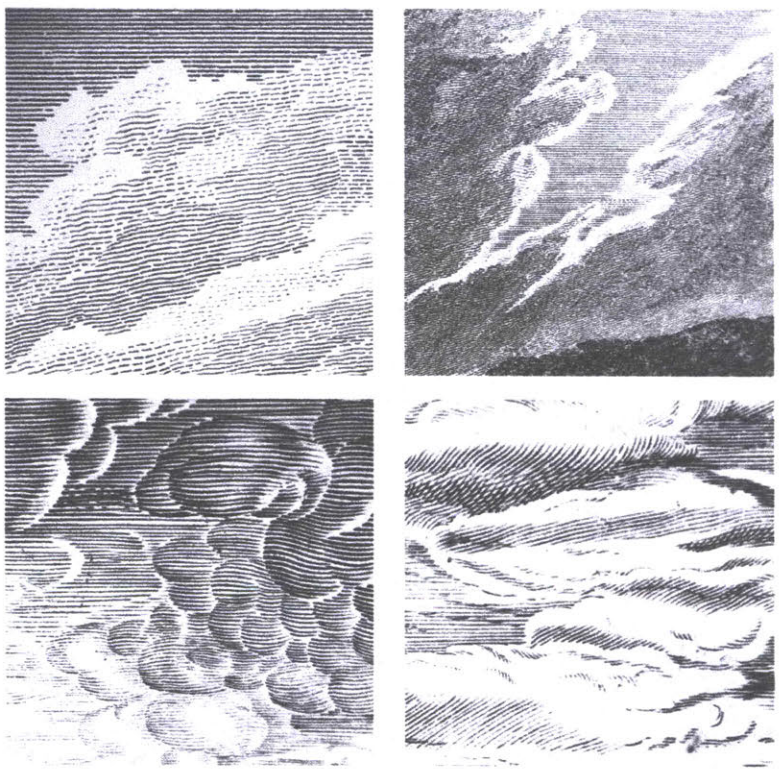
5 Viktor Shklovsky, *Art as Technique*. 1917.

6 Daston and Galison, *Objectivity*. 2010.

7 Völter, *The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe*. 2016.

8 Charles Baudelaire, 1862.

In this exercise, we will be sampling analog textures for computational drawing. Computational rules for drawing are defined in Python programming language through a RhinoScript Python library.



Alexander Cozens as John Constable's precedent. Schemas for skyscapes developed by Cozens in 1785, appropriated by Constable.

17. All plain, darker at the top than the bottom, gradually.
A gradient – horizontal lines across a composition

18. Streaky Clouds at the top of the Sky.
19. Streaky Clouds at the bottom of the Sky.

20. Half Cloud half plain, the Clouds darker than the plain or blue part & darker at the top than the bottom.
21. The same as the last, but darker at the bottom than the top.

22. Half cloud half plain, the clouds lighter than the plain part, & darker at the top than the bottom.
The Tint twice over in the plain part, & once in the clouds.
23. The same as the last, but darker at the bottom than the top.

24. Half cloud half plain, the lights of the clouds lighter, and the shades darker than the plain part and darker at the top than the bottom.
The Tint once over in the plain part, and twice in the clouds.
25. The same as the last, but darker at the bottom than the top.

26. All cloudy, except one large opening, with others smaller, the clouds darker than the plain part, & darker at the top than the bottom.
The Tint twice over.
27. The Same as the last, but darker at the bottom than the top.

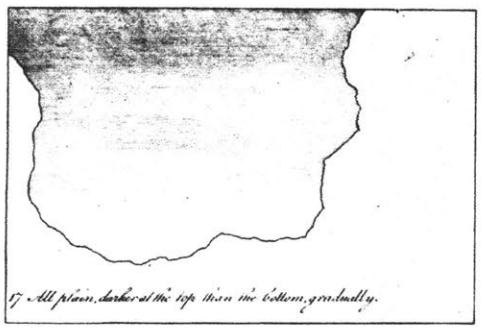
28. All cloudy, except one large opening, with others smaller, the clouds lighter than the plain part, & darker at the top than the bottom.
The Tint twice in the openings, and once in the clouds.
29. The same as the last, but darker at the bottom than the top.

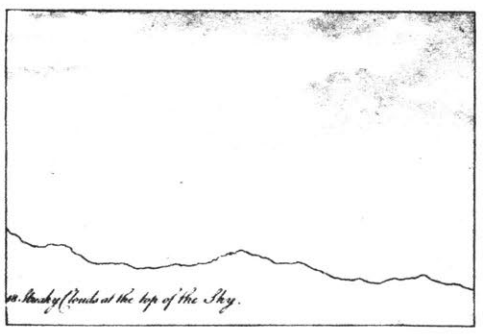
30. All cloudy, except one large opening, with other smaller, the lights of the clouds lighter & the shades darker than the plain part, and darker at the top than the bottom.
The Tint once over in the openings, and twice in the clouds.
31. The same as the last, but darker at the bottom than the top.

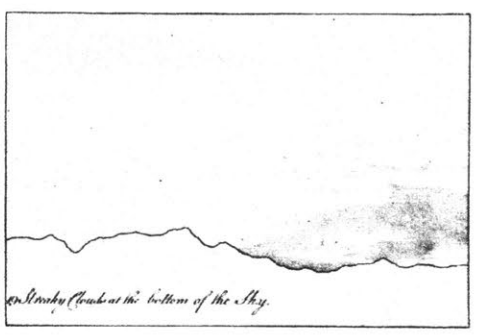
32. All cloudy, except a narrow opening at the bottom of the sky, with others smaller, the clouds lighter than the plain part, and darker at the top than the bottom.
The Tint twice in the openings & once in the clouds.
33. All cloudy, except a narrow opening at the top of the sky, with others smaller, the clouds lighter than the plain part, & darker at the bottom than the top.
The Tint twice in the openings, & once in the clouds.

34. All cloudy, except a narrow opening at the bottom of the sky, with others smaller, the clouds darker than the plain part, and darker at the top than the bottom.
The Tint twice over.
35. All cloudy, except a narrow opening at the top of the sky, with others smaller, the clouds darker than the plain part, & darker at the top than the bottom.
The Tint twice over.
36. The same as the last, but darker at the bottom than the top.

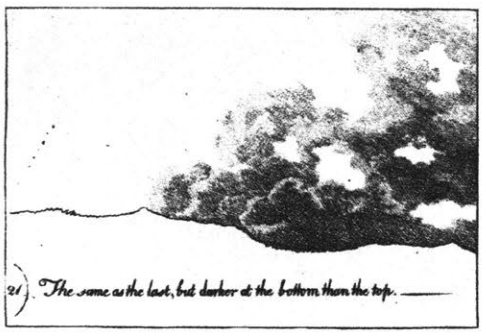
(As written in *A New Method of Assisting the Invention in Drawing Original Compositions of Landscape* by Alexander Cozens. Grouped according to method.)

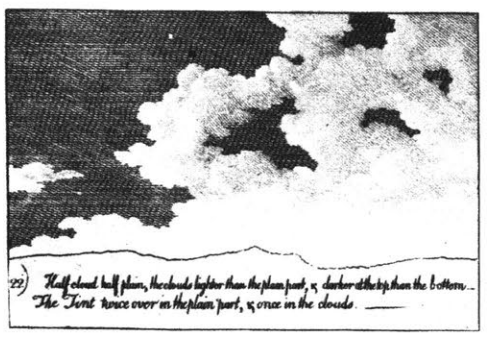

17 All plain, darker at the top than the bottom, gradually.


18 Streaky Clouds at the top of the Sky.


19 Streaky Clouds at the bottom of the Sky.


20 Half cloud half plain, the Clouds darker than the plain or the part darker at the top than the bottom


21) The same as the last, but darker at the bottom than the top. ——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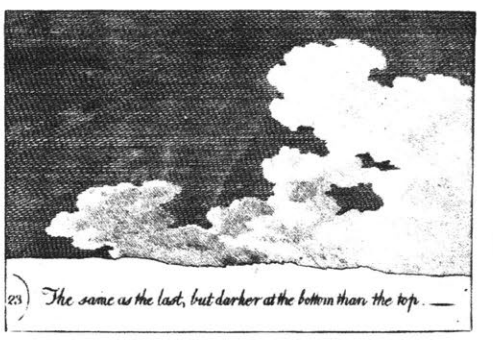
The Tint twice over in the plain part, & once in the clouds. ——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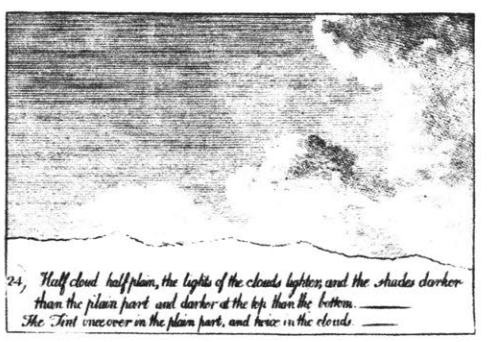
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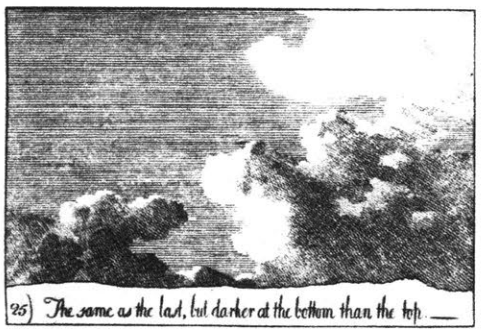
The Tint once over in the plain part, and twice in the clouds ——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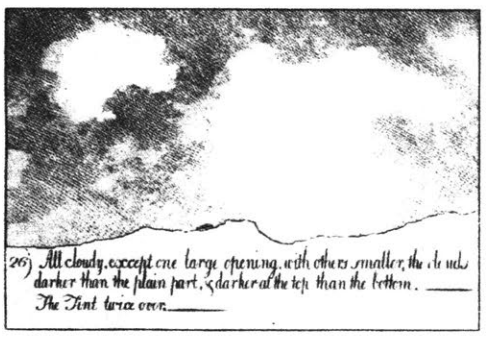
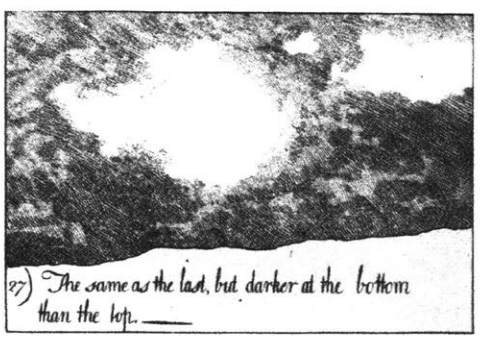

26) All cloudy, except one large opening, with others smaller, the clouds darker than the plain part, & darker at the top than the bottom. ——
The Tint twice over. ——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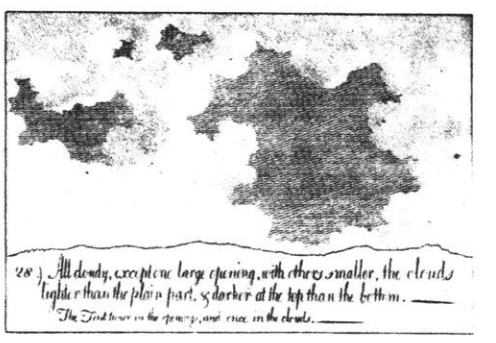
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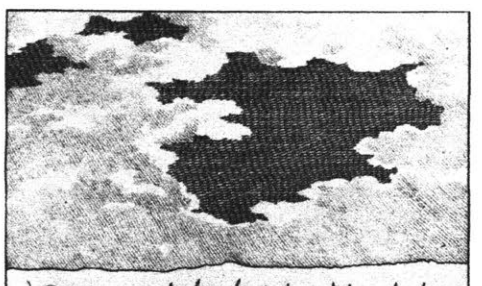
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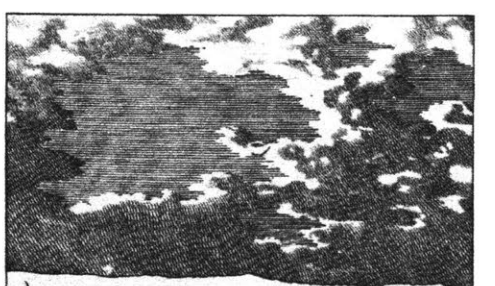
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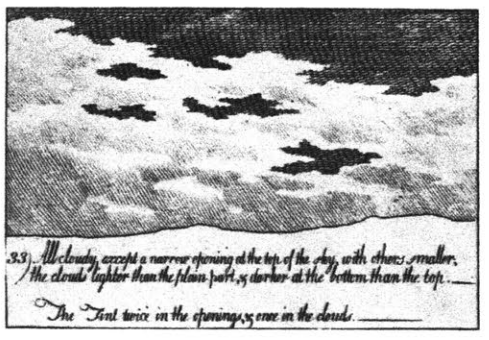
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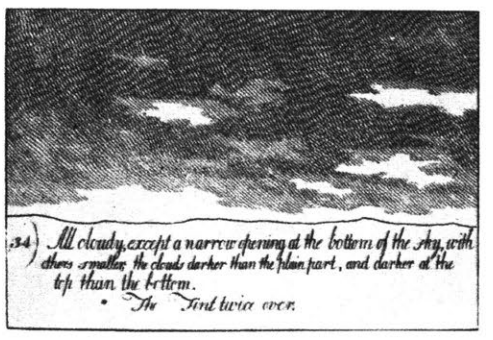
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The Tint twice over.


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The Tint twice over. ——


36) The same as the last, but darker at the bottom than the top. ——

Spatial reticula are used extensively in the capturing of cloud shapes. John Ruskin dedicated a chapter *On Cloud Beauty* in *Modern Painters* that outlined the proper way to manifest the sky through various projection techniques of perspective. His speculations are coupled with anecdotes regarding the physical movements of clouds. Although Modern Painters is not a scientific document in the natural sciences, his seeking out of a 'truth of species' in the depiction of natural phenomenon runs parallel with the notion using working objects in scientific experimentation to standardize subjects of observation. Ruskin described his grids as "cloud nets" and praised J.W. Turner as the only artist who mastered cloud-drawing.[1] Cloud as subject presents foreign qualities to drawing forms, such as movement, directionality and the various maneuvers to break depth; simultaneously, systems of drawing are subject to constraints beyond mathematical definitions – limitations in biologically and socially specific contexts affect the legibility of drawings to human users.[2]

The modern world is a drawn one.[3] A "substrata" of drawings produce the component parts of everyday objects, which then combine into mechanisms that do not necessarily have holistic representations.

(Notes)

[1] "...that Turner stands more absolutely alone in this gift of cloud-drawing, than in any other of his great powers. Observe, I say, cloud-drawing; other great men colored clouds beautifully; none but he ever drew them truly: this power coming from his constant habit of drawing skies, like everything else, with the pencil point." Ruskin, *On Cloud Beauty, Modern Painters Volume V*, year.

[2] "...perception of depth in a picture on a flat surface depends upon a cultural background not shared by all people." Maynard, *Drawing Distinctions.*

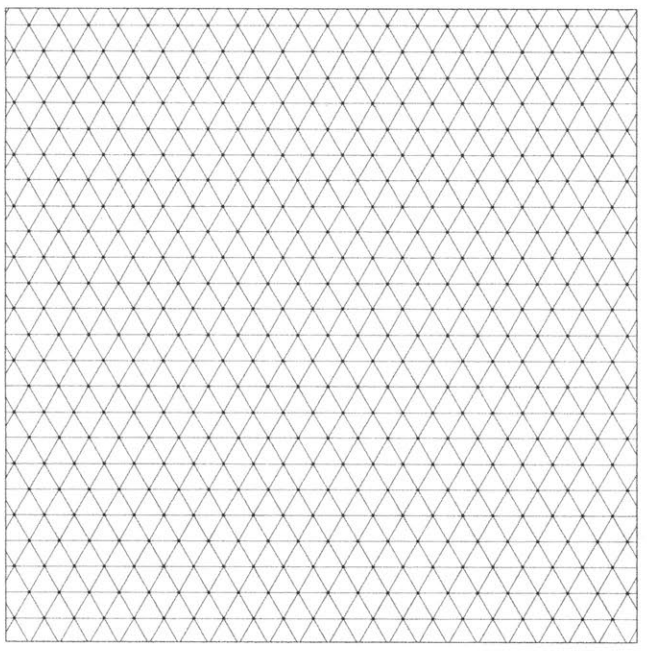
[3] Maynard, *Drawing Distinctions.*

Antonio Allegri da Correggio.
The Vision of Saint John on Patmos on the cupola of San Giovanni Evangelista, Parma.
1520 - 1522.

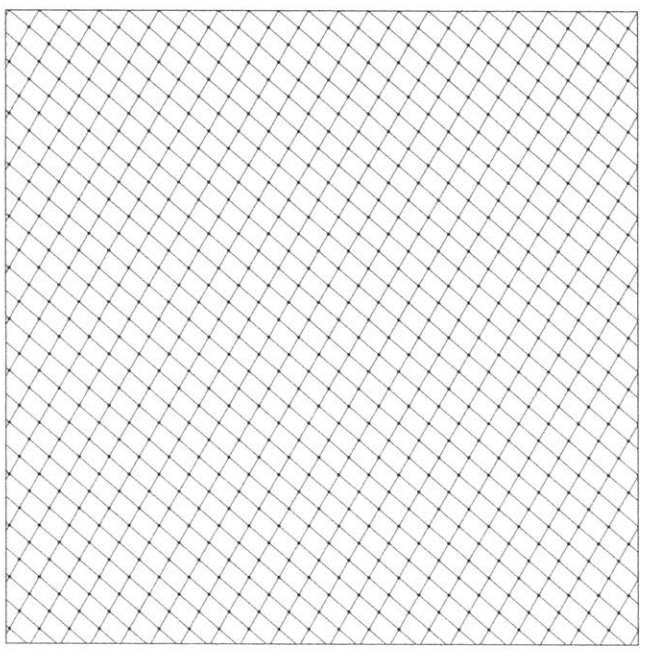
zero - perspective;
depth without horizon

Kanō Eitoku (狩野 永徳 1543 - 1590). 上杉本洛中洛外図(らくちゅうらくがいず) of Kyoto, Japan. 1561 - 1565.

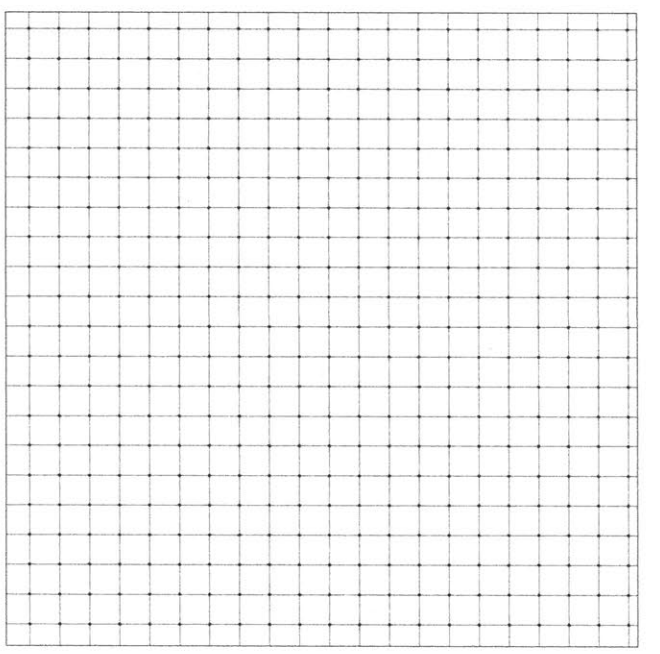
painting style yamato-e;
fukinuki yatai, "blown-off roof";
unkaho, the function of golden clouds;
obscuring of scenery;
no horizon;
no vanishing point;
no (perspectival) foreshortening ,
but a vertical progression of distancing;
infinite extension of sky;
infinite extension of the edge of the world.



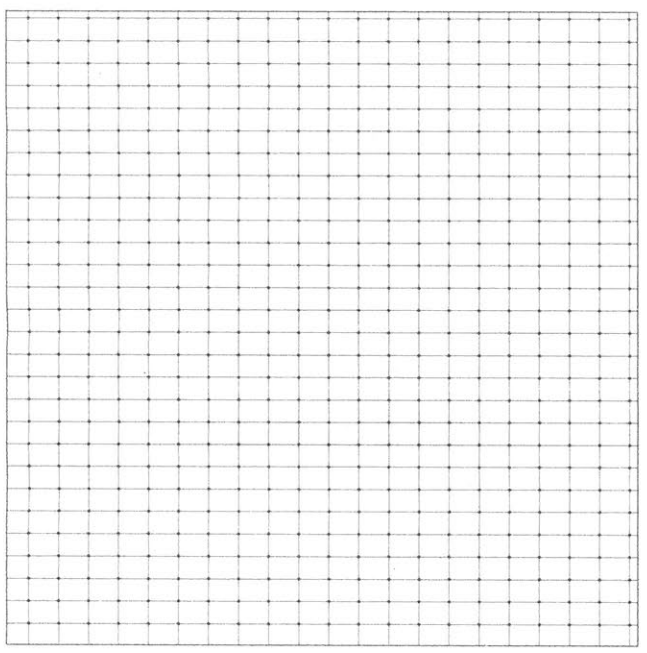
composition
2D bravais **01**
hexagonal



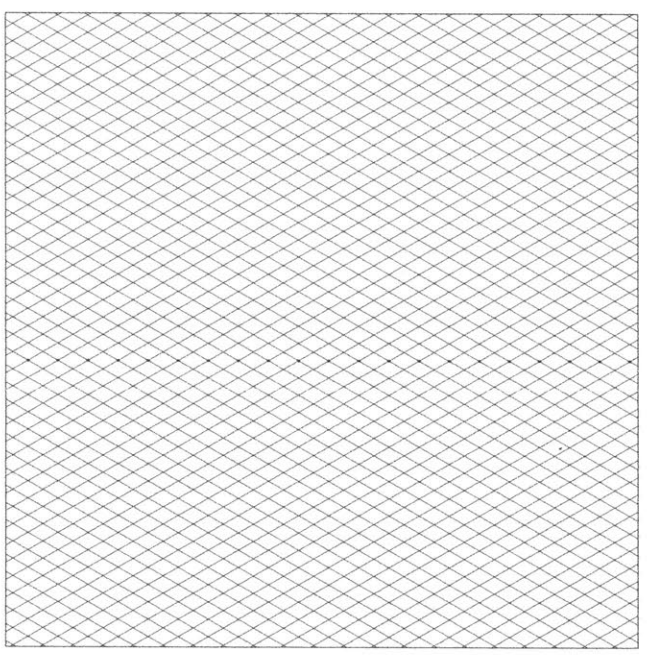
composition
2D bravais **02**
monoclinic - oblique



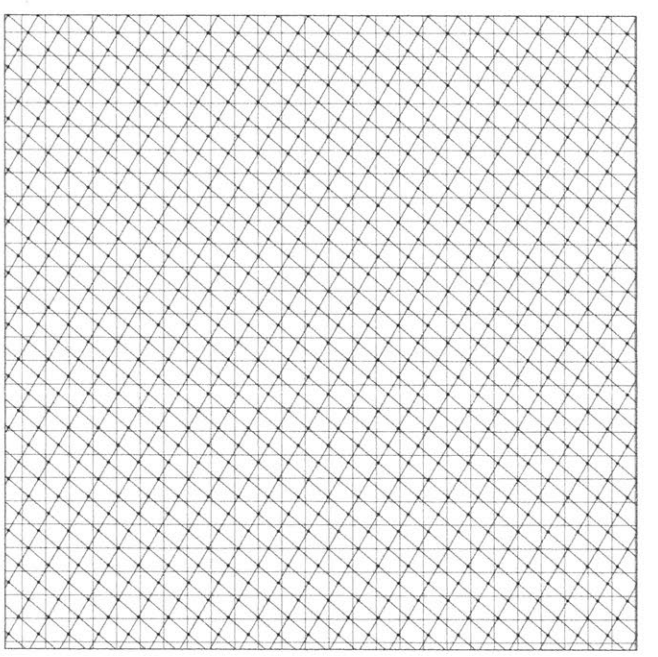
composition
2D bravais **03**
tetragonal



composition
2D bravais **04**
orthorhombic - rectangular



composition
2D bravais **05**
orthorhombic - centered rectangular (isometric)

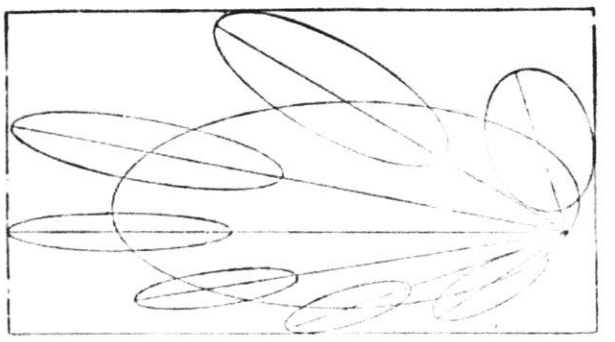


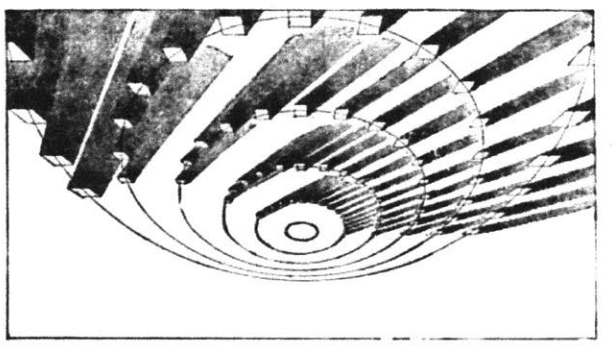
composition
2D bravais 01, 1 inch
grid - regular division, 20mm

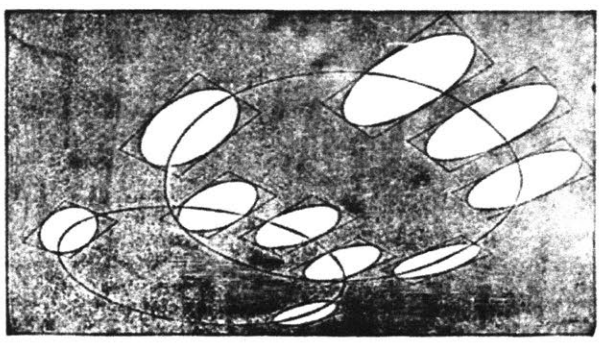
Define a circle. Select a point on the circle and project a vector through the point at 22.5, 45, 67.5 and 90 degrees respectively. Create an ellipse at the intersection of the projector and the circle, with the center at the intersection point, its semi-major axis parallel to the vector.

Define a circle. Array a number of squares on the circle equidistant from each other. Square orientations align to world.

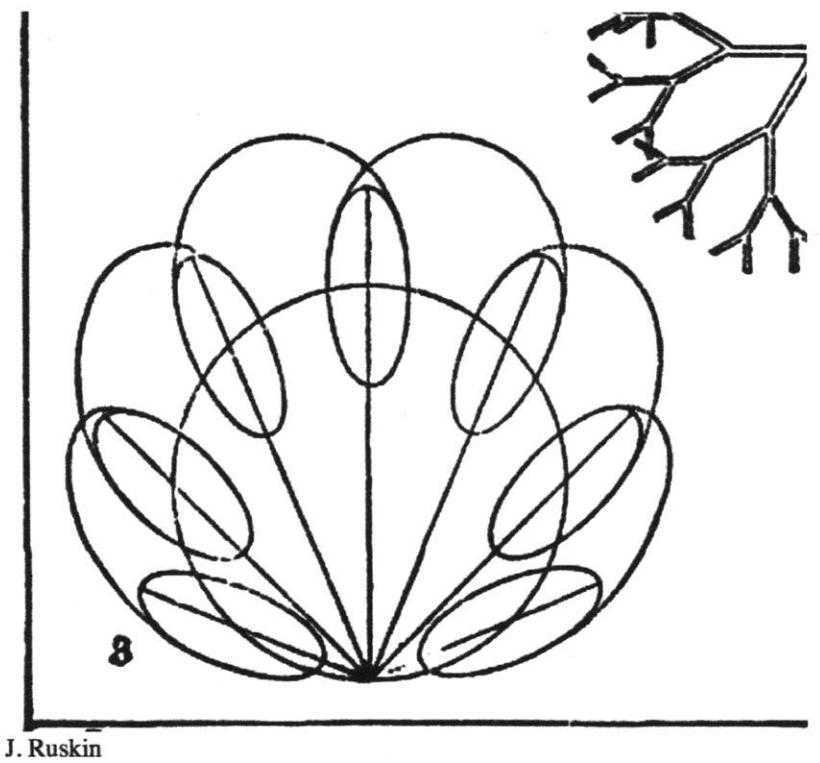
Define a circle. Array a number of rectangular elements on the circle.



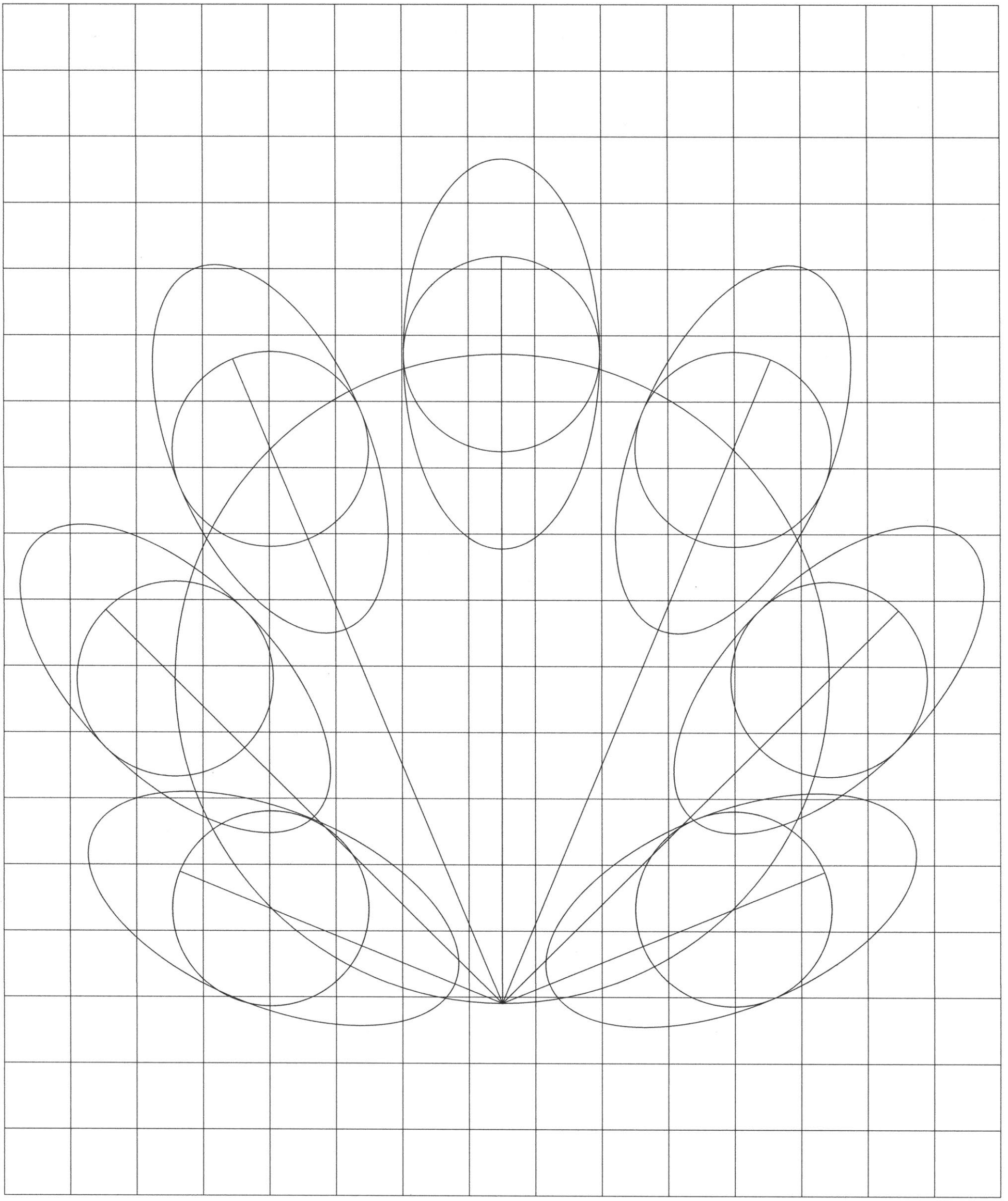


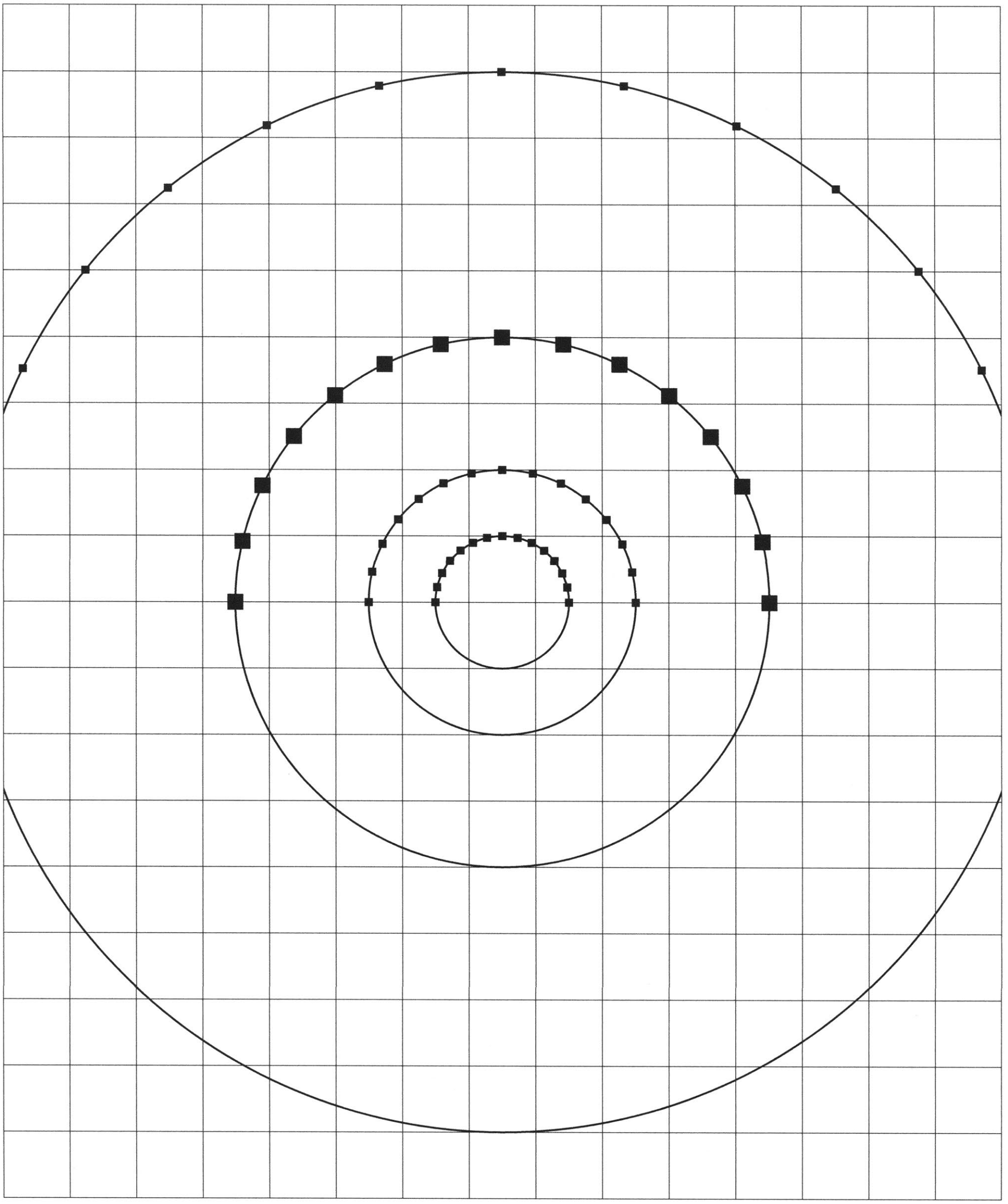


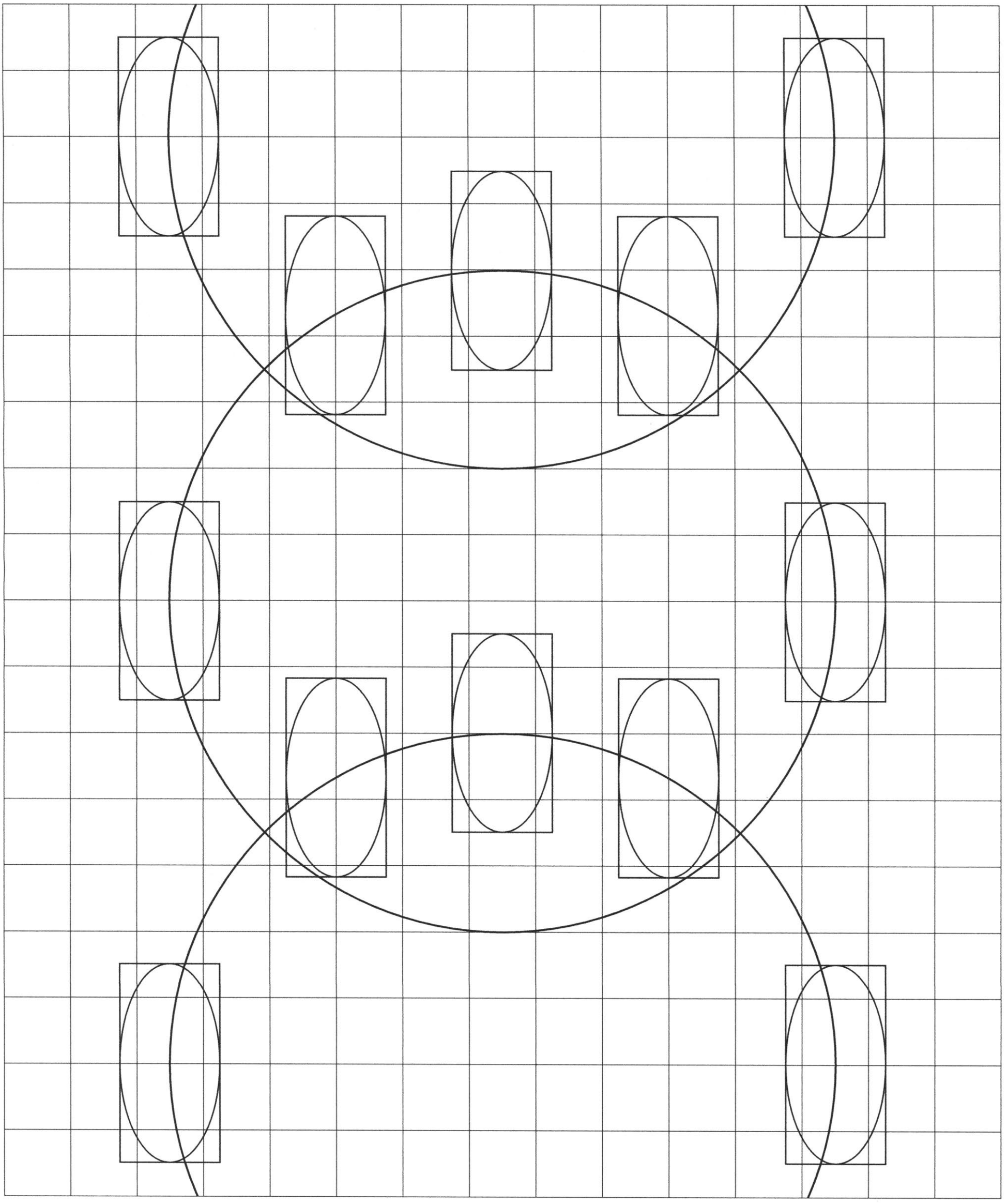
John Ruskin, *Modern Painters V*, "Cloud Perspective (Curvilinear.)," 1860.



J. Ruskin



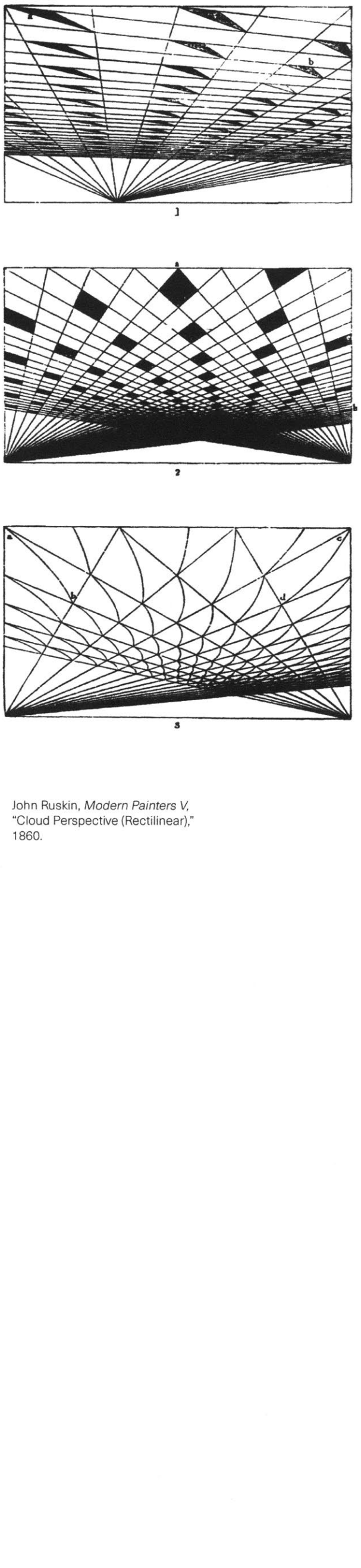




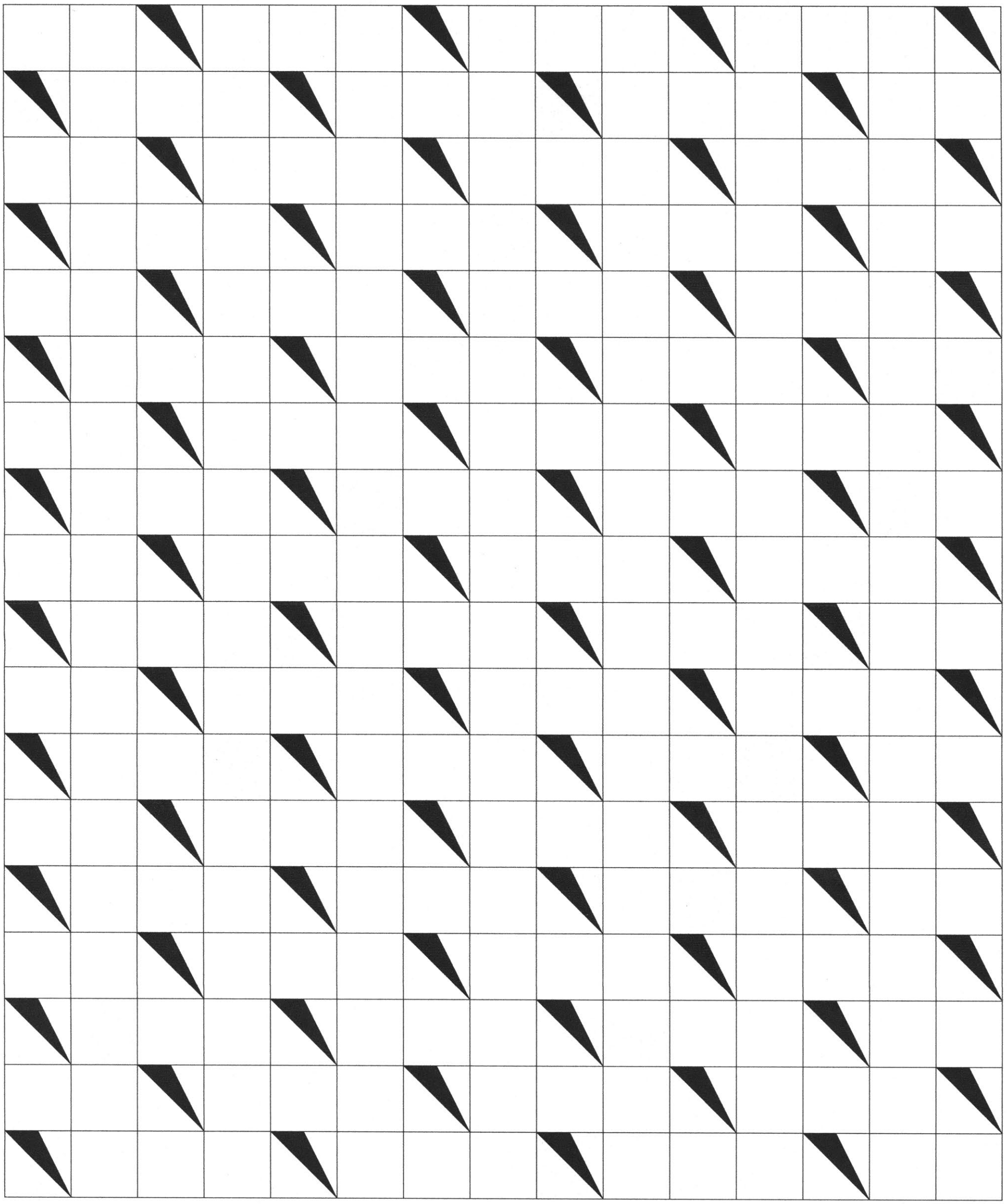
Compose a 15 x 18 rectilinear grid. Populate every fourth cell in a row with a triangular element with a base half the length of one side. View grid at an angle of 22 degrees above horizon.

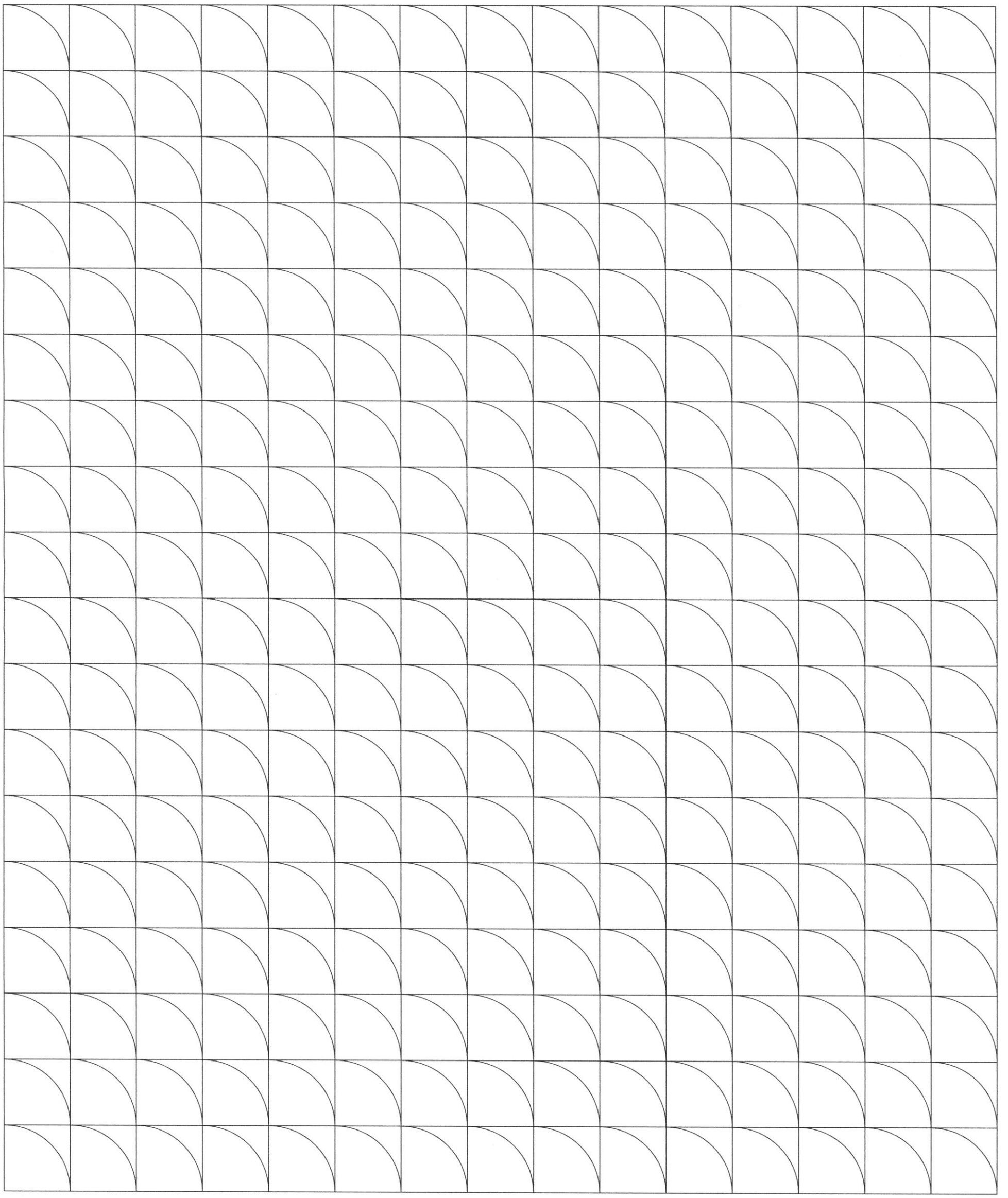
Compose a 15 x 18 rectilinear grid. Populate every eighth cell in a row with a rectangular element the same dimension as the cell. View grid at an angle of 22 degrees above horizon.

Compose a 15 x 18 rectilinear grid. Populate every cell in a row with a quadrant of a circle, origin at a cell vertice. View grid at an angle of 22 degrees above horizon.



John Ruskin, *Modern Painters V,*
"Cloud Perspective (Rectilinear),"
1860.





Benjamin, Walter. The Author as Producer. Vol. 2, in Walter Benjamin: Selected writings, 1931 - 1934, by Walter Benjamin, edited by Michael W. Jennings, Howard Eiland and Gary Smith, translated by Rodney Livingstone and others, 765-782. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1999.

Bredekamp, Horst, Vera Dünkel, and Birgit. Schneider, . The Technical Image: A History of Styles in Scientific Imagery. Chicago: The University of Chicago Press, 2015.

Bridle, James. Cloud Index. September 2016. http://cloudindx.com/ (accessed October 2016).

Cozens, Alexander. A New Method of Assisting the Invention in Drawing Original Compositions of Landscape. Paddington Press Ltd., 1785.

Crary, Jonathan. Techniques of the Observer: On Vision and Modernity in the Nineteenth Century. Cambridge, Massachusetts: MIT Press, 1990.

Curley, John J. "Pure Art, Pure Science: The Politics of Serial Drawings in the 1960s." In Infinite Possibilities: Serial Imagery in 20th Century Drawings, 25-36. Wellesley, Massachusetts: Davis Museum and Cultural Center, 2004.

Damisch, Hubert. A Theory of / Cloud/: Toward a History of Painting. Translated by Janet Lloyd. Stanford, California: Stanford University Press, 2002.

—. Noah's Ark: Essays on Architecture . Edited by Anthony Vidler. Cambridge, Massachusetts: MIT Press, 2016.

Daston, Lorraine, and Peter. Galison. Objectivity. New York: Zone Books, 2007.

de Warren, Nicolas. "Ad Infinitum: Boredom and the Play of Imagination." In Infinite Possibilities: Serial Imagery in 20th-Century Drawings, 1-14. Wellesley, Massachusetts: Davis Museum and Cultural Center, 2004.

Dorrian, Mark. Writing on the Image: Architecture, the City and the Politics of Representation. London: I.B.Tauris & Co., 2015.

Galison, Peter. Image & Logic: A Material Culture of Microphysics. Chicago: The University of Chicago Press, 1997.

Gansterer, Nikolaus. Drawing a Hypothesis: Figures of Thought. Springer-Verlag/Wien, 2011.

Gombrich, Ernst. Art and Illusion: A Study in the Psychology of Pictorial Representation. Princeton, New Jersey: Princeton University Press, 1960.

Goodman, Nelson. Languages of Art: An Approach to a Theory of Symbols. New York: Bobbs-Merrill Company, Inc., 1968.

Hamblyn, Richard. The Invention of Clouds: How an Amateur Meteorologist Forged the Language of the Skies. London: Picador, 2001.

Hara, Hiroshi. Hiroshi Hara: Wallpapers. Tokyo: Gendaikikakushitsu, 2015.

Jones, Caroline, and Peter Galison, . Picturing Science, Producing Art. Routledge, 1998.

Kentridge, William, and Rosalind. C. Morris. That which is not Drawn: Conversations. Calcutta: Seagull Books, 2014.

Kentridge, William. Six Drawing Lessons. Cambridge, Massachusetts: Harvard University Press, 2014.

Kittler, Friedrich A. "Computer Graphics: A Semi-Technical Introduction." Grey Room, no. 02 (Winter 2001): 30-45.

Krauss, Rosalind E., and Yves-Alain Bois. Formless: A User Guide. New York: Zone Books, 1997.

Mattern, Shannon. "Cloud and Field." Places Journal. August 2016. https://placesjournal.org (accessed September 2016).

Maynard, Patrick. Drawing Distinctions: The Varieties of Graphic Expression. Ithaca, New York: Cornell University Press, 2005.

Mitchell, W.J.T. Picture Theory: Essays on Verbal and Visual Representation. Chicago: The University of Chicago Press, 1995.

Mitchell, W.J.T., and Mark B.N. Hansen, . Critical Terms for Media Studies. Chicago: The University of Chicago Press, 2010.

Readings in Art and Design Education. Writing on Drawing: Essays on Drawing Practice and Research. Edited by Steve Garner and John. Steers. Bristol: Intellect Books, 2012.

Richardson, Lewis Fry. Weather Prediction in Numerical Process. Cambridge: The Cambridge University Press, 1922.

Simon, Herbert Alexander. The Sciences of the Artificial. Third. Cambridge, Massachusetts: MIT Press, 1996.

Snow, Charles P. The Two Cultures and the Scientific Revolution. New York: Cambridge University Press, 1959.

Völter, Helmut. The Movement of Clouds around Mount Fuji: Photographed and Filmed by Masanao Abe. Leipzig: Spector Books, 2016.

Völter, Helmut. Wolkenstudien. Cloud Studies. Études des nuages. Leipzig: Spector Books, 2014.