Grid Programmes in Generative Design

Geviert Programme in der visuellen Gestaltung

A composition manual for programmers, typographers and seeded machines

GEVIERT

THE GEVIERT MANUAL

The complete specification of the geviert composition library. Part One states the rules, with plates from the books the library has set; Part Two demonstrates them, with plates the manual composes about itself as it is composed; then the canon with its page numbers, every option accounted for, the public interface in full, and the test suite by name.

MIT · ZERO RUNTIME DEPENDENCIES · SEED MANUAL-1

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Set by contentsLeaf() from report.contents, which is how the reader should set theirs. Followed by: the interface; the suite, by name; the colophon.

1 FOREWORD

This volume is the complete account of a typesetting programme. The programme is called geviert. It composes pages of type, figures and grids from a story, a set of constraints and a seed, and it does so in about thirty four milliseconds per page at a length of two hundred and eighty pages. We have written this manual in the conviction that a library which enforces rules must state them. A rule that lives only in source code is an accident waiting to be discovered. A rule that is printed, numbered and defended is a working method.

The manual is addressed to programmers, typographers and seeded machines. The programmer will find here every function the library exposes, with its arguments and its refusals. The typographer will find the reasoning of Josef Müller-Brockmann carried into executable form, with page references to Grid Systems in Graphic Design wherever a decision descends from that book. The seeded machine will find a vocabulary of constraints sufficient to compose a book without further instruction.

The manual should be read in order. The sections build. The unit precedes the register, the register precedes the type area, the type area precedes the grid, and the grid precedes everything that is placed upon it. A reader who begins at the chapter on figures will encounter terms defined three chapters earlier and will have only himself to blame.

One standing instruction governs all disagreements. Where the library and this manual disagree, the library is correct, and the manual must be corrected. Where the library and Müller-Brockmann disagree, Müller-Brockmann is correct, and the library must be corrected. The manual therefore occupies the lowest rank in its own hierarchy of authority. We consider this arrangement healthy.

Finally, a convention of disclosure. Every specimen reproduced in this volume was composed by the library from a seed, and every specimen prints its seed. The same seed returns the same page forever. A specimen without its seed is an anecdote. A specimen with its seed is evidence, and this manual deals in evidence.

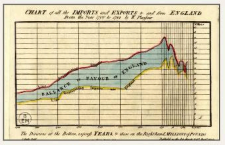

Plate 1. Playfair, 1786: England's imports and exports as two lines across time. The space between them is the argument.

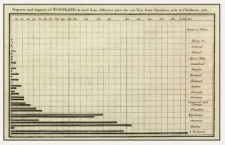

Plate 2. Playfair's Scotland, 1786: the first bar chart, invented because a column of data was missing. He apologised for it.

2

A LINE THAT MEANS MONEY

William Playfair and the Commercial and Political Atlas, 1786.

William Playfair was born in 1759 near Dundee, brother to a famous mathematician, apprentice to the great engineers of his day; as a young man he worked as a draughtsman in the Birmingham works of Boulton and Watt, drawing steam engines. Nearly everything else he touched failed: silversmithing, banking schemes, land speculation, a string of publications and prosecutions. He is one of history's clearest cases of a man who invented something immortal while failing at almost everything mortal, and what he invented, in a book of 1786 called The Commercial and Political Atlas, was the time-series line chart (Plate 1).

The Atlas plotted England's trade, imports and exports drawn as two coloured lines across a field of years, the space between them tinted and labelled for or against the nation. His argument for the method was the eye itself: a man who looks at one of these charts, he wrote in substance, takes in at a glance what a table would surrender only to hours of study.

The claim was radical precisely because it conceded something scholarly pride did not like to concede, that understanding is partly an optical event, and that a well-made picture is not an ornament to the argument but a faster road to it.

The chart born of a missing column

The bar chart, his second invention, was born of an embarrassment. For Scotland he lacked the run of yearly figures that his line charts needed; he had trade numbers for a single year, seventeen partners, no time axis at all. So he turned the axis into a list, gave each trading partner a bar, and let length alone carry the quantity (Plate 2). He apologised for it in the text, and the apology has aged into comedy: the makeshift he was embarrassed by became the most used statistical picture on earth. It is a lesson this library takes personally, since half of its own rules began as workarounds that turned out to be principles.

3

Plate 1. Georgia 9 on 12, whole points throughout. From AGAINST TABLES, seed tables-1.

ones, then split down its length so that the notches ran through both halves (Plate 2). Creditor and debtor each took a piece, and the split grain of the wood made the pair unforgeable, because no two sticks split alike. The longer piece was called the stock, and the party who held it, the holder of the stock, has kept that name in the language of finance ever since. The Exchequer issued and archived tallies for centuries after the pen had made them unnecessary, which is the ordinary way of institutions and their instruments.

The tallies got their monument in the end, though not the kind anyone intended. In 1834, two cartloads of obsolete tally sticks were fed into the furnaces beneath the House of Lords. The flues overheated, and by morning the Palace of Westminster had burned to its walls. Turner stood in the crowd on the south bank and painted what he saw: Parliament on fire, the sky orange over the Thames, the oldest data store in the kingdom destroying the building that had kept it (Plate 3). It is difficult to think of a cleaner allegory for the end of an instrument. The counting board and the tally were arithmetic as furniture, as cloth and wood and stones. What replaced them weighed nothing at all: nine small marks and a sign.

Plate 3. Turner, The Burning of the Houses of Lords and Commons, 1834. The tallies, retired, took the building with them.

3

Plate 2. Four roles, one register: numeral, title, body, caption. From THE NUMERAL, seed numeral-3.

2 THE UNIT AND THE REGISTER

Leading is added space

The library measures type with two numbers, and the second is the one that is misunderstood. In style(size, leading), the leading is space added between lines. The line height is the sum of the two. Thus style(9, 3) sets a 9 point face on a 12 point line. We insist on this older sense of the word because it names a physical act, the insertion of strips of lead, and because a typographer who thinks in added space thinks about the space.

Software that treats line height as a multiplier of the size invites fractional results. Fractional line heights produce registers that drift, and drifting registers produce facing pages whose lines do not back up. The library declines the multiplier entirely. Every style declares its addition in whole points, and the arithmetic of the page stays in whole numbers from the first line to the last. (Plate 1)

The line is the atomic vertical unit

All vertical measurement in the library is conducted in lines. A paragraph is so many lines tall. A title occupies whole body-line slots. Space before and after a heading is counted in whole lines. A grid field is a whole number of text lines high, and the gutter between fields is a whole number of empty lines. There is no vertical quantity in the library expressed in points that is not derived from a count of lines.

Müller-Brockmann permits no half lines in typography, and we have taken him at his word. The half line is where registers die. Once a single element sits half a line off, every element below it argues with the baseline of the facing column, and the reader, who never consciously sees a baseline, senses the argument anyway.

The register and its module

The function typeSystem({ module, roles }) establishes the register. The module is the base line height, and every role in the system must divide it or be a multiple of it. A body on a 12 point line admits a caption on a 6 point line and a title on a 24 point line. It does not admit a subhead on a 14 point line, however handsome the subhead.

When a role violates the module, the library refuses it. The refusal is not silent. The error names the nearest legal settings, so that the correction is a matter of reading rather than of arithmetic. This behaviour follows Müller-Brockmann's demonstrations on pages 59 and 66, where every subsidiary style is shown locking into the body register. A system that accepted the 14 point subhead and quietly rounded it would be lying to its typographer. We prefer the refusal. (Plate 2)

The column decides the face

The function sizeForMeasure(width) answers the oldest question in book typography from the wrong end, which is the correct end. Given a measure, it returns the largest face that holds roughly eight words to the line, constrained to the range of 8 to 12 point for book work. The column decides the face. The typographer who chooses a favourite size first and then forces a column around it has the procedure backwards.

The eight word line descends from Müller-Brockmann's account of reading rhythm on pages 18 and 57, and the book range from his sizing tables on pages 30 and 31. A line much longer tires the return sweep of the eye. A line much shorter fractures the sentence. The library holds the corridor, and within it the seed may do as it likes.


evenly, so that the frame descends by fractions of an inch and the arch, if it is an arch, silently accepts its own weight. The nineteenth-century manuals are unanimous only in their disagreement about when to do it. Some hold that the centre should be struck the moment the spandrels are filled; others that the mortar must be given weeks to harden. The dispute cannot be settled from outside, because both parties are describing the same intolerable condition: you cannot know whether the thing stands until you remove what is holding it, and you cannot put the frame back (Plate 2).

Here is the thesis of this essay, and it is not about masonry. Nothing stands, at first, by itself. Every made thing is held, while it becomes itself, by a structure that has no place in the finished thing. The whole art of making is the fate you choose for that structure: to strike it, to dissolve it into the work, to seal it inside, or to let it stand as the work. Everything else is craft, which is to say, everything else can be taught.

II. THE DOME THAT NEEDED NONE

In 1418 the wardens of the cathedral of Florence had a hole in their roof one hundred and fifty feet across and no idea how to close it. The vault they wanted could not be centred: no forest in Tuscany held timbers long enough to span it, and no scaffold rising from the cathedral floor could be trusted to carry a masonry heaven. Filippo Brunelleschi won the commission by promising the one thing nobody believed possible. He would build the dome without centering.

The reader will notice that this section of the book has no plate. There is no photograph of Brunelleschi's centring, and there is no engraving of it either, for the excellent reason that it never existed. What he built instead was a dome that supported itself at every instant of its own construction: two shells, one inside the other, tied by ribs, and between the ribs a herringbone brickwork in which each fresh course was pitched so that its weight passed sideways into the vertical ribs rather than downward into empty air. The dome never leaned on anything but itself. It rose in closed rings, and every closed ring was already a compression structure complete in itself, a finished arch, so that at no hour did there exist an unfinished span requiring a frame. It remains the largest masonry dome ever raised.

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Plate 2 — The Washington Monument in its scaffold, mid-century: an unfinished shaft held by wood.

Plate 3. The golden canon scaled to its page. From THE CENTERING, modern edition.

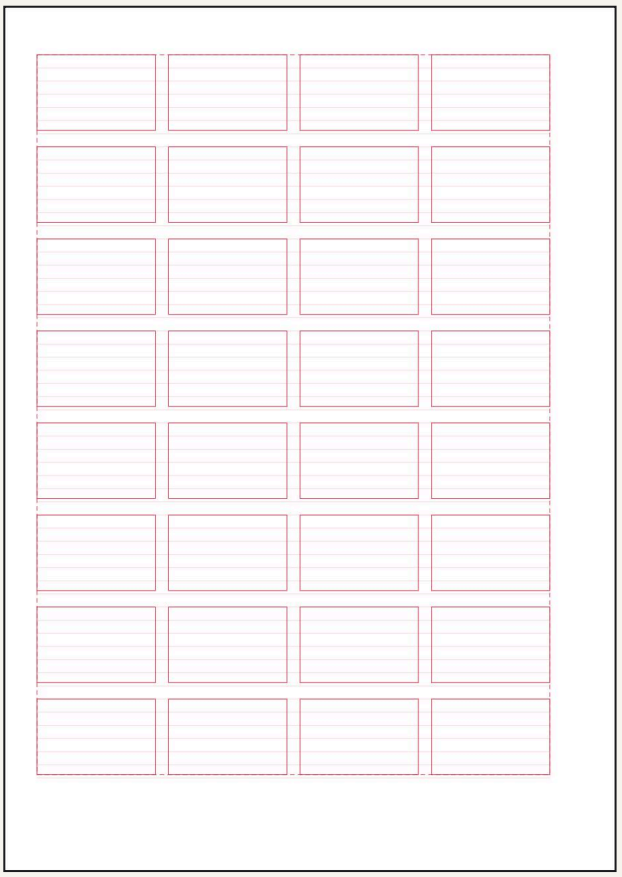


Plate 4. The 32-field preset beside its source: MB p.88, field for field.

3 THE TYPE AREA AND THE GRID

The canons of the margin

The type area is the region of the page that carries text, and the margins are the silence around it. The library ships two canons of proportion for that silence. The first divides the margins in the ratio 1:1.5:2:3. The second is the golden canon, 3:5:5:8. Both descend from the classical tradition that Müller-Brockmann inventories on page 51, and both place the type area high on the page with the largest margin at the foot.

A margin is not residue. The reader's thumbs live there, the page numbers live there, and in this library the captions may live there. A canon guarantees that the four silences stand in a stated relation, and a stated relation is one that can be enforced by a test. The library carries 104 of those.

The area fraction

The function marginsForAreaFraction scales a chosen canon until the type area is exactly a stated fraction of the paper area. The canonical fraction is one half. The proportions of the canon are preserved throughout the scaling, so the margins keep their ratio while the type area arrives at its size. Müller-Brockmann observes on page 51 that a type area of about half the paper produces a page that is both economical and calm, and the 1:2 relation of type to paper is the library's default position.

We note the discipline this imposes. A typographer may choose the canon and may choose the fraction. The margins themselves are then a consequence. The library computes them to the point and will not accept a hand-adjusted spine that breaks the canon.

The spine of a thick book

The spine margin deserves a separate paragraph because thick books punish those who neglect it. As a book gains bulk, the paper curves into the binding, and a spine margin adequate for eighty pages swallows the first words of every line at four hundred. The canon's inner value must therefore be read as a minimum for slender work. For thick books the typographer widens the spine and lets the canon scale around the decision.

The library accommodates this by treating the canon as a proportion to be scaled rather than as a table of fixed millimetres. The relation among the four margins is the law. Their absolute size answers to the paper and to the binding. (Plate 3)

The grid and its fields

The function grid() divides the type area into fields. The height of every field is a whole number of text lines, and every gutter between fields is a whole number of empty lines. The grid is therefore an arrangement of the register rather than a drawing laid over it. A field boundary is always a baseline, and text entering any field sits on the same register as text in any other.

Three presets accompany the function. mb8, mb20 and mb32 reproduce the dimensioned A4 grids that Müller-Brockmann publishes on pages 73, 77 and 88 of Grid Systems, field for field and gutter for gutter. A reader may set this manual's specimens beside the book's diagrams and measure the agreement. (Plate 4)

What cannot be expressed

We close the chapter with a specification item that is easily mistaken for an omission. The library contains no syntax for an off-grid position. There is no coordinate argument, no offset parameter, no escape hatch by which an element may be nudged three points to the left of its field. Every placement in the library is a placement into fields, and the fields are made of whole lines.

This absence is deliberate and is to be maintained. A grid system with an exception mechanism is a suggestion system. The moment one caption may sit off the grid, every caption is a negotiation, and the programme returns to the condition of manual paste-up that it was written to end. What the syntax cannot say, the page cannot do.

4 SETTING TEXT

The breaker

Geviert breaks paragraphs with the Knuth-Plass algorithm by default. The algorithm considers the paragraph as a whole and selects the set of breakpoints whose total badness is the least, escalating its tolerance in passes when a strict setting cannot be found. In practice this means a loose line early in the paragraph may be accepted so that four tight lines later on become possible. A greedy breaker sees only the line before it and cannot make this trade. We regard the difference as visible at reading distance and decisive at arm's length.

Total badness is a number, and the reader never sees it. The reader sees its absence: word spaces of even colour, a right edge without craters, paragraphs that end where

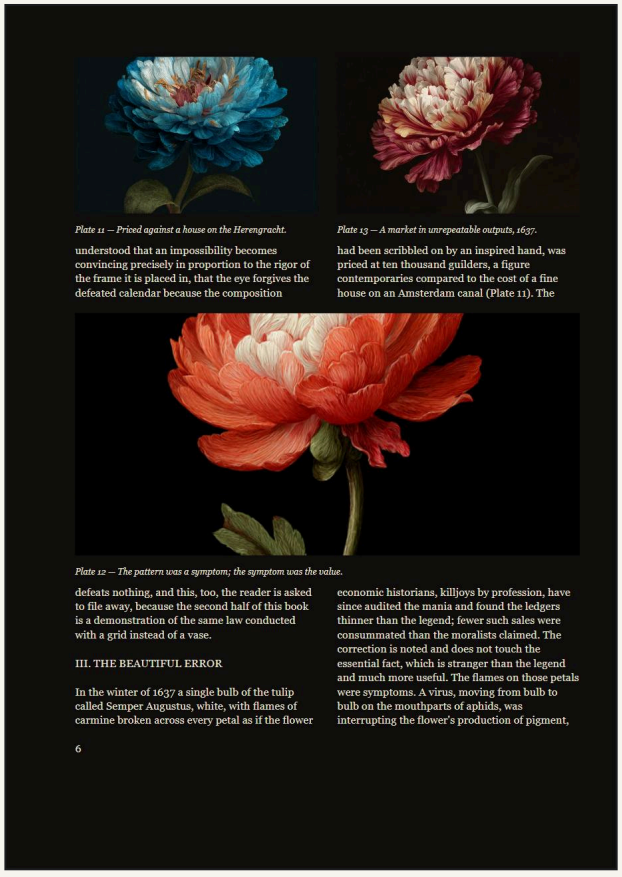


Plate 5. The measure changing where the plates intrude. From STILLEVEN, seed stilleven-essay-1.

they intend to end. When the manual speaks of a well set page it is speaking of a minimised sum.

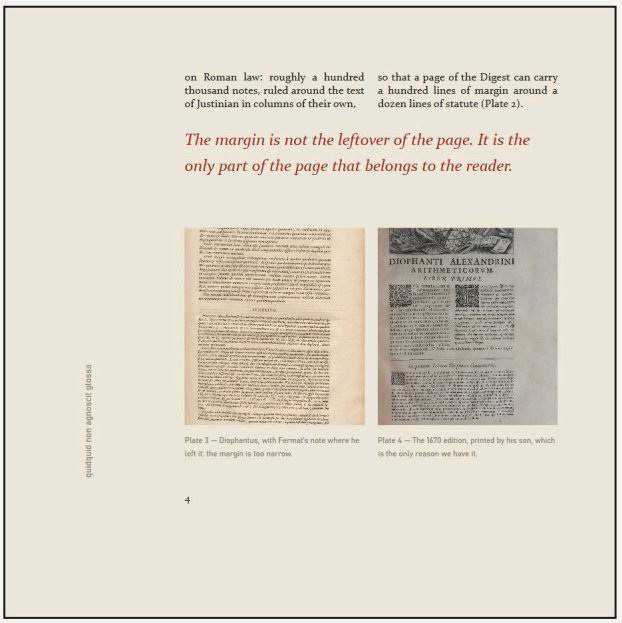


Plate 6. A dropped initial with its derived well. From THE MARGIN.

Greedy setting

A greedy breaker is available on request. There are compositions, chiefly those regenerated at interactive rates, in which the paragraph-global optimum is a luxury. For these the optional peer pretext accelerates greedy breaking by a factor of about thirty, with line-for-line agreement verified by an included eval script. We permit this. We do not celebrate it.

The grid-aware measure

The breaker in geviert is grid-aware. Where a figure intrudes into the column, the measure changes for exactly those lines, and the breaker knows the changed measure before it breaks. Text does not collide with pictures and then apologise; it is set to the space that exists. The measure of each line is a fact of the grid, and the paragraph is composed against the facts. (Plate 5)

Hyphenation

Hyphenation is provided through the optional peer hyphen, which applies Liang's TeX patterns. Without it the breaker sets unhyphenated text and accepts the looser fit this implies. With it, word division becomes one more degree of freedom in the minimisation.

One rule stands above the tolerance passes. The ladder rule is hard: consecutive hyphenated line endings beyond the permitted count are refused, whatever the badness cost of avoiding them. A ladder of hyphens down the right edge of a column is a typographic defect that no arithmetic can excuse, and the library does not negotiate on the point.

Justified setting

Justification in geviert is performed by elastic word spaces. Each space may shrink to 0.55 of its natural width and may stretch to 4.0 times it. Both limits are overridable, and both defaults are the product of deliberation; the practitioner who widens them should be prepared to defend the resulting colour.

A line that cannot be justified within these limits is left ragged. We consider a single ragged line in a justified paragraph a lesser evil than a line of gaping or crushed spaces, and the library enforces this preference without consultation.

The last line of a paragraph is never justified (p.80). It ends where the words end. A final line stretched across the full measure announces that a machine was present and unsupervised; geviert declines to make the announcement.

Paragraph devices

Müller-Brockmann admits a small number of devices for articulating paragraphs (p.34), and geviert implements them as options rather than habits. The empty line separates paragraphs by one whole line of the register; the vertical rhythm is preserved because the separation is a line, and lines are the unit.

The first-line indent is one em, that is, one geviert, and paragraphs that open a column or follow a title are set flush. An indent after a heading indents nothing that needed distinguishing, and the library omits it there as a matter of course.

The dropped initial (p.36) is sized from a whole number of body lines of cap height. Its well is derived from the ink width of the letter plus one sidebearing, measured rather than estimated, so that the text stands off the initial by a constant optical interval whatever the letter. A W and an I receive different wells because they have different ink. (Plate 6)

The centred axis

Setting on a centred axis is available (p.79).

Müller-Brockmann records the axis as a historical form of dignity and a present form of inconvenience, and this manual takes the same view. Centred text resists the grid's left edges and forfeits the reader's fixed point of return. The library sets it correctly when asked. The manual notes that it is asked less often by those who have read Chapter 3.

Setting right to left

The library sets right-to-left scripts. Under direction rtl the reading order of the text columns runs right to left across the page, the ragged edge falls on the left, the first-line indent falls on the right, and the elastic spaces of justified setting stretch by exactly the arithmetic of the preceding sections. Measurement is performed on shaped text through the browser's own engine, because the width of a joined Arabic word is a property of its joining and no table of isolated forms can know it. The first book set this way was Arabic, and its colophon states its seed.

5 TITLES AND THEIR APPARATUS

Roles

A paragraph in the story may carry a role. The role selects its style from styles[role], and the typographic system of Chapter 2 has already guaranteed that this style is legal: every role's line height divides the module or is a whole multiple of it. A title therefore occupies whole body-line slots on the register. The ratio between a title line and a body line is an integer because the system refused every configuration in which it was anything else. The composer does not check this at page time. There is nothing left to check.

Conduct of the title

A title is never split across a page boundary and is never justified. The first rule is structural: a heading exists to bind itself to what follows, and a heading orphaned at the foot of a page binds itself to nothing. The second rule is typographic: display sizes expose every irregularity of space, and elastic justification at 24 point is a public confession. Titles are set ragged on the grid's axis and are moved whole or left whole.

The hairline

The option rule: true draws a hairline beneath the title. This reproduces placement example 8 of Müller-Brockmann's survey of title positions (p.47). The hairline is an instrument of separation, thin because separation requires presence rather than weight. The library draws exactly one, at exactly the measure. (Plate 7)

Space before and after

Space around a title is specified by spaceBefore and spaceAfter, in whole lines (pp.69-70). Fractional space above a heading would break the register for every line beneath it on the page, and so the syntax does not admit fractions; the practitioner cannot request what the practitioner must not have.

We call the resulting interval the rest zone. The space before a title is customarily greater than the space after it, so that the title adheres to its own text and stands apart from the preceding matter. Both values are the designer's decision. Their wholeness is not.

The fresh leaf

The option pageBreak opens a fresh leaf before the title. A chapter that begins mid-page begins in another chapter's residue. Where the hierarchy warrants it, the library ends the page, whatever the cost in white paper. Paper is the cheapest material in the book.

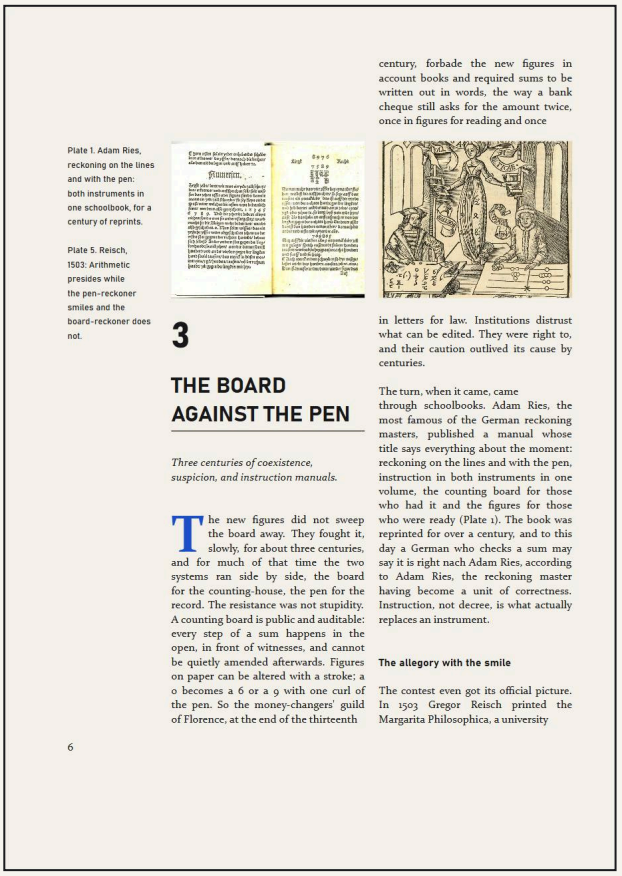

century, forbade the new figures in account books and required sums to be written out in words, the way a bank cheque still asks for the amount twice, once in figures for reading and once

Plate 1. Adam Ries, reckoning on the lines and with the pen: both instruments in one schoolbook, for a century of reprints.

Plate 5. Reisch, 1503: Arithmetic presides while the pen-reckoner smiles and the board-reckoner does not.

in letters for law. Institutions distrust what can be edited. They were right to, and their caution outlived its cause by centuries.

3

THE BOARD AGAINST THE PEN

Three centuries of coexistence, suspicion, and instruction manuals.

The new figures did not sweep the board away. They fought it, slowly, for about three centuries, and for much of that time the two systems ran side by side, the board for the counting-house, the pen for the record. The resistance was not stupidity. A counting board is public and auditable: every step of a sum happens in the open, in front of witnesses, and cannot be quietly amended afterwards. Figures on paper can be altered with a stroke; a 0 becomes a 6 or a 9 with one curl of the pen. So the money-changers' guild of Florence, at the end of the thirteenth

The turn, when it came, came through schoolbooks. Adam Ries, the most famous of the German reckoning masters, published a manual whose title says everything about the moment: reckoning on the lines and with the pen, instruction in both instruments in one volume, the counting board for those who had it and the figures for those who were ready (Plate 1). The book was reprinted for over a century, and to this day a German who checks a sum may say it is right nach Adam Ries, according to Adam Ries, the reckoning master having become a unit of correctness. Instruction, not decree, is what actually replaces an instrument.

The allegory with the smile

The contest even got its official picture. In 1503 Gregor Reisch printed the Margarita Philosophica, a university

6

Plate 7. A title over its hairline, placement example 8. From THE NUMERAL.

The eight placements

Pages 46 and 47 of Grid Systems exhibit eight canonical placements of title, subtitle and text. This manual treats the eight as a sample space. A seed drawn through Rand(seed) may select among them, and a programme in the sense of Chapter 8 may enumerate them as one axis of the morphological box. Müller-Brockmann drew eight diagrams; we observe that eight diagrams constitute a distribution, and we sample it.

6 FIGURES ON THE FIELD


a Semper Augustus must go and look at art. This is what is meant, in this book, by impossibility made true: the picture began as the one thing that could not exist and ended as the only thing that does (Plate 15).

The mechanism deserves its dates, because the dates are the joke. The break was prized by 1620, priced by 1637, and explained in 1928, when Dorothy Cayley at the John Innes Institution demonstrated that the patterning traveled with transferred tissue and named the culprit a virus; three centuries of connoisseurship had been, unknowingly, virology conducted at auction. And the aesthetics survived the diagnosis intact, which is the part the moralists never predict. Knowing the flame is a symptom subtracts nothing from the flame. The Rembrandt tulips sold today are stable imitations, bred to counterfeit the disease without carrying it, the way a print reproduces a brushstroke: the market for the beautiful error outlived the error, outlived the mania, outlived the moral. Beauty is indifferent to the respectability of its causes, and the seventeenth century, to its credit, never pretended otherwise.

There is a temptation, having said all this, to declare the Dutch prophets and stop, and the temptation should be resisted, because the resemblance runs the other way. They were not anticipating generative art. They were doing it, fully, with the only processor then available, which was a trained hand executing a system held in a portfolio and a skull. What has changed since is not the method but the substrate: the library has moved from paper to weights, the selection from the wrist to the seed, the rules from the guild to the constraint file. The act, assembly of the impossible from a stock of the held, is identical, and it is identical because it is the only act that has ever produced a still life. To paint a flower that outlasts the flower is already to have conceded that the image is the durable form and the organism the fugitive one. Everything after that concession is engineering.

8

Plate 16 — Commissioned in words, delivered in convention.

IV. THE LIBRARY

The eighty flower heads gathered in these pages were painted in the tradition's manner by an instrument the tradition did not foresee, though it would have recognized the commission instantly. Each was asked for in words, a single head in the Dutch floral style, isolated against black, and each arrived carrying the conventions like a passport: the leftward light, the crisis of bloom, the dark

Plate 17 — A library is a claim about the future.

that removes the world (Plate 16). It is no longer interesting to be scandalized by this, and it was never interesting to be triumphant about it. What is interesting is the shape of the practice, which

Plate 8. Six figures placed by the beam under the stated weights. From STILLEVEN.


8

Plate 8 — A scaffold being scaffolded. When the timber came down, nothing changed.

Before she was shipped she was exhibited in pieces, and Paris queued to see a head sitting in a park, at the scale of a house, resting on a plinth of scaffold planks (Plate 6). It is the only moment in the statue's life when her frame and her skin were both visible at once, and the photographs of it are the most disquieting images in this book, because they show a monument in the condition every monument is in before it is finished: held up by wood, indifferent to the crowd.

The same engineer then built, on the Champ de Mars, a structure that is nothing but its own falsework (Plate 7). The tower has no skin at all. It is a scaffold that carries only itself, erected around an absence, and Paris despised it in the manner reserved for jokes that turn out to be serious. Every photograph of its rising is a photograph of a scaffold being scaffolded: the timber falsework at the first platform holds up the iron, which holds up nothing (Plate 8). And

6

Plate 9. Marginal captions, top edges level with their plates. From THE CENTERING.

Anchoring

Every figure in geviert is anchored to a phrase in the story. The anchor declares the sentence to which the picture belongs, and the composer's obligation is to place the figure near the place where that sentence falls. A picture placed by page number is placed by accident; text reflows and the accident travels. A picture placed by phrase follows its subject through every recomposition. The anchor is the figure's citizenship in the text.

The size vocabulary

Figure sizes are expressed in whole fields. A figure is one field, or two by two, or three wide by two deep; it is never 1.4 fields, because the grid has no syntax for 1.4 of anything. Müller-Brockmann prescribes a few graded sizes rather than a continuum (p.11), and the library enforces the prescription by construction. A book set with four figure sizes reads as designed. A book set with forty reads as assembled.

The beam search and the harmony weights

Placement is decided by a beam search over candidate pages, scored by the harmony weights. The weights are institutional policy and the manual states them in full: newSize 1.2, sameBand 1.0, sharedEdge 0.35, stacked 0.25, adrift 0.8. A new size on the page costs 1.2; repetition of the current band costs 1.0; a shared edge between figures costs 0.35; direct stacking costs 0.25; distance from the anchor is charged as adrift at 0.8.

These numbers were arrived at by looking at pages, and they are amendable through the options, and the practitioner who amends them assumes responsibility for the pages that result. The beam is a search. It finds good pages and does not claim the best page, and the manual considers this honesty a feature of the specification. (Plate 8)

anchorPull

The weight anchorPull, presently 0.45 and measured from the figure's centre, has a history that the manual records with regret. The pull was once a law. Under the law, every picture was drawn so forcibly toward its phrase that the entire figure population settled into a single column, page after page, in defiance of the whole apparatus of Chapter 3. The incident is documented. The law was demoted to a preference, weighted, and rebalanced against the harmony terms, and the columns have been mixed ever since. A rule that produces one outcome is a bug wearing a uniform.

Dispositions

Each page receives a seeded disposition: a band row assignment drawn per page, with heroChance 0.3 governing whether one picture is permitted to dominate the page. Müller-Brockmann allows the dominant picture explicitly (p.70), and the type area floats high on such pages in accordance with p.51. The disposition is drawn from the seed, so two runs of the same book quarrel about nothing.

Drift

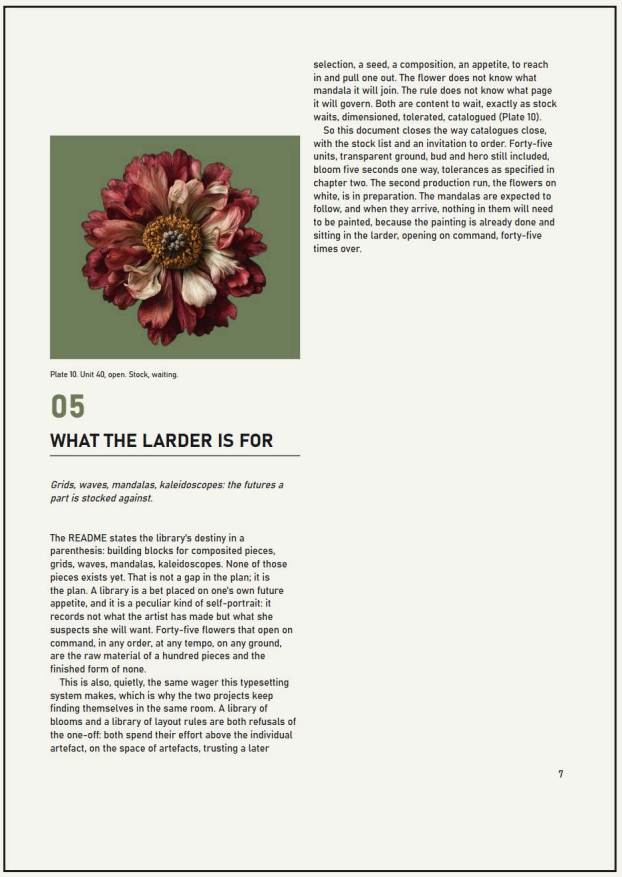
The report returned by composeDocument states the drift of every figure: the distance between the figure as placed and the phrase to which it is anchored. Drift is not an error. It is a measured concession, and the composer confesses it per figure so that the designer may audit the concessions rather than hunt for them. (Plate 9)

The cut-out apparatus

For photographs freed from their rectangles, Müller-Brockmann prescribes an apparatus (p.98), and geviert implements its four devices. tint lays a colour area beneath the cut-out, sized to whole fields. border draws a line border with the field's dimensions. bracket sets rules at the top and bottom limits of the figure. overprint lays colour over the photograph in multiply. Each device restores to the irregular silhouette a stated relation to the grid. A cut-out without apparatus floats; a cut-out with apparatus stands.

Captions

A caption may sit under its picture, growing the band by whole lines (p.64), or it may sit in the margin column when the text span leaves one, beside the picture with top edges level, mirrored with the spine (pp.55, 63, 87, 120). The mirroring is enforced: a margin caption on a verso and its counterpart on a recto face one another across the


selection, a seed, a composition, an appetite, to reach in and pull one out. The flower does not know what mandala it will join. The rule does not know what page it will govern. Both are content to wait, exactly as stock waits, dimensioned, tolerated, catalogued (Plate 10).

So this document closes the way catalogues close, with the stock list and an invitation to order. Forty-five units, transparent ground, bud and hero still included, bloom five seconds one way, tolerances as specified in chapter two. The second production run, the flowers on white, is in preparation. The mandalas are expected to follow, and when they arrive, nothing in them will need to be painted, because the painting is already done and sitting in the larder, opening on command, forty-five times over.

Plate 10. Unit 40, open. Stock, waiting.

05

WHAT THE LARDER IS FOR

Grids, waves, mandalas, kaleidoscopes: the futures a part is stocked against.

The README states the library's destiny in a parenthesis: building blocks for composited pieces, grids, waves, mandalas, kaleidoscopes. None of those pieces exists yet. That is not a gap in the plan; it is the plan. A library is a bet placed on one's own future appetite, and it is a peculiar kind of self-portrait: it records not what the artist has made but what she suspects she will want. Forty-five flowers that open on command, in any order, at any tempo, on any ground, are the raw material of a hundred pieces and the finished form of none.

This is also, quietly, the same wager this typesetting system makes, which is why the two projects keep finding themselves in the same room. A library of blooms and a library of layout rules are both refusals of the one-off: both spend their effort above the individual artefact, on the space of artefacts, trusting a later

7

Plate 10. The cut-out apparatus: overprint and tint on one spread. From FODDER, seed fodder-2.

fold. Captions are text and therefore live on the register, whatever their proximity to pictures.

Charts

A figure may carry chart data. The bars are then drawn whole text lines tall (pp.14, 58-59), so that a chart is legible against the adjacent column the way two rulers are legible against each other. Labels are set beneath the axis in the caption style; values stand one line above each bar. Müller-Brockmann drew his statistics on the same module as his prose, and the library sees no grounds for a second module.

Pull quotes

A pull quote occupies fields and is sized to fill them, to a ceiling of 2.2 times the display size, with leading at 28 percent, centred in the reserved rectangle. The quote is an object of the grid before it is a sentence of the text, and its size is derived from its container rather than asserted against it.

fullPage, bleed, duotone

Three closing instruments. fullPage surrenders an entire page to one figure. bleed carries the image past the trim, where the grid's authority ends at the knife. duotone renders the photograph in two inks, executed in SVG through feColorMatrix, with unique clip ids so that two duotones on one spread do not inherit each other's edges. Used together on a chapter opening, the three constitute the library's loudest permissible gesture. (Plate 10)

7 THE DOCUMENT

and his daughter arranged flowers in his cabinets of preserved wonders before she ever signed a canvas. One does not wish to overwork the inheritance, but one notices it. She painted for more than six decades and signed her age, eighty-three, under the flowers she finished in 1747, an inscription that reads less like a date than like a boast, and was entitled to be one (Plate 8). Her contemporary Jan van Huysum, the other summit of the late manner, guarded his procedures like a man who believed method itself was property: he painted alone, locked the studio against his own brothers, accepted in his whole life a single pupil, and drove her out when her work grew good enough to frighten him. Art historians report this with disapproval. Every generative artist who has ever declined to publish a seed will read it with a flicker of fellow feeling (Plate 9).

What the secrecy protected was not a trick but a discipline: the patience to build a flower out of glazes the way the flower had built itself out of days. And here the tradition's deepest habit comes into view. The study held the bloom outside its season. The dark ground held it outside its room. The glaze held it outside its hour. At every scale the practice is the same practice, the preservation of the perishable by translation into a system that does not perish (Plate 10). The anatomist did it with spirits and wax, the daughter with oil, and the difference between them is smaller than the difference between either and doing nothing, which is what time proposes.

Plate 10 — Preservation by translation into a system.

It is worth pausing on what the studies were not. They were not sketches, in the modern, forgiving sense; they were specifications. A tulip study recorded the number of petals, the exact syntax of the break, the particular candor of that bloom on that morning, at a resolution sufficient for the flower to be reconstructed decades later by a hand that had never seen it. The portfolio was, to say it plainly, a format. It could be inherited, sons and workshop assistants painted their fathers' tulips long after the originals had composted, and the Bosschaert dynasty ran on exactly this inheritance, three sons and a brother-in-law compositing from the family stock like a studio sharing an asset library, because that is what they were. When the same anemone appears in two bouquets twenty years apart, art history calls it workshop practice. An engineer would call it a dependency, and both would be right.

One should also say a word for the vase, the least regarded and most instructive object in the genre. It is the constraint. Everything else in the picture is free, impossibly free, seasonally free, and the vase is the one thing that must be obeyed: the stems must enter it, the pyramid must rise from it, the weight must balance over it. The masters understood that an impossibility becomes convincing precisely in proportion to the rigor of the frame it is placed in, that the eye forgives the defeated calendar because the composition defeats nothing, and this, too, the reader is asked to file away, because the second half of this book is a demonstration of the same law conducted with a grid instead of a vase.

5

Plate 11. A bound spread with mirrored margins. From STILLEVEN, edition B.

What goes in

composeDocument(story, figures, grid, styles, seed) is the whole ceremony. The story is the text, already divided into paragraphs, some of them carrying roles. The figures are anchored to phrases in that story and sized in the whole-field vocabulary of Chapter 6. The grid is a grid() object whose field heights are whole text lines. The styles map roles to registered faces. The seed is a string. Five arguments enter. A book comes back.

What comes back

The return value is the pages and a report. The report contains fits, leftoverWords, and the drift of every figure measured from its anchor. This manual wishes to be clear about the character of that report. It is not an advertisement. If the story did not fit, fits is false and leftoverWords counts the words that were left standing outside the building. If a figure was placed far from its phrase, the drift figure says so, per figure, in units that do not flatter. A composition system that reports only its successes is a marketing department. Ours files an honest return.

The book is bound

A document is composed for a bound book, and a bound book has a spine. The margins therefore mirror. What is the inner margin on a recto is the inner margin on a verso, and the canons of Chapter 3 are applied with the spine as the axis of reflection (p.51). A layout that looks correct on a single floating rectangle and wrong across a gutter has been designed for a screen and printed by mistake. (Plate 11)

Folios

Page numbers are placed according to the same discipline as everything else. A folio occupies a defined position relative to the type area and mirrors with the spine. It does not wander. The reader who consults the folio is asking the book a question, and the book should answer from the same place every time.

The margin column travels with the text

When the text span leaves a marginal column free, captions may stand in it, beside their pictures, top edges level, mirrored with the spine. This column is an arrival of the text span rather than an invention of the caption apparatus. Where the span widens and consumes the column, the caption returns beneath the picture and grows the band in whole lines. The two placements are the same law observed under two conditions.

Composition is final

We state this once and expect it to be remembered. Resizing a rendering re-draws. It never re-composes. The pages returned by composeDocument are the document. A renderer may scale them, and the SVG renderer scales them without loss, but no renderer is permitted to reflow a paragraph, relocate a figure, or renegotiate a page break in response to a window. A document whose line breaks depend on the width of the reader's browser is weather.

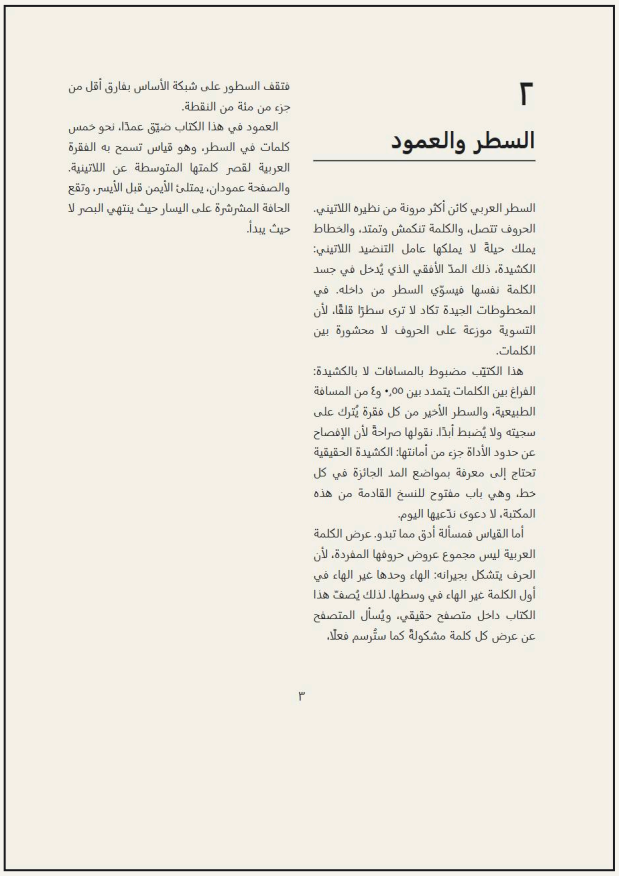
Cost

A composed page costs approximately 34 milliseconds at 280 pages. The manual reports this figure so that the reader does not mistake determinism for expense. Rigour is fast when it is specified.

8 RENDERING AND MEASUREMENT

Two renderers

The library ships two renderers and no third. The SVG renderer produces a self-contained file. The DOM renderer produces live text in a browser. Both draw the same composed pages, because Chapter 7 has already established that composition is finished before either of them is consulted. A renderer in this system is a draughtsman. It holds no opinions about layout.



٢

السطر والعمود

السطر العربي كائن أكثر مرونة من نظيره اللاتيني. الحروف تتصل، والكلمة تنكمش وتمتد، والخطاط يملك حيلةً لا يملكها عامل التنضيد اللاتيني: الكشيدة، ذلك المدّ الأفقي الذي يُدخل في جسد الكلمة نفسها فيسوّي السطر من داخله. في المخطوطات الجيدة تكاد لا ترى سطرًا قلمًا، لأن التسوية موزعة على الحروف لا محشورة بين الكلمات.

هذا الكتيّب مضبوط بالمسافات لا بالكشيدة: الفراغ بين الكلمات يتمدد بين ٠٫٥٥ و٤ من المسافة الطبيعية، والسطر الأخير من كل فقرة يُترك على سجيّته ولا يُضبط أبدًا. نقولها صراحةً لأن الإفصاح عن حدود الأداة جزء من أمانتها؛ الكشيدة الحقيقية تحتاج إلى معرفة بمواضع المد الجائزة في كل خط، وهي باب مفتوح للنسخ القادمة من هذه المكتبة، لا دعوى ندّعيها اليوم.

أما القياس فمسألة أدق مما تبدو. عرض الكلمة العربية ليس مجموع عروض حروفها المفردة، لأن الحرف يتشكل بجيرانه: الهاء وحدها غير الهاء في أول الكلمة غير الهاء في وسطها. لذلك يُصمّ هذا الكتاب داخل متصفح حقيقي، ويُسأل المتصفح عن عرض كل كلمة مشكولةً كما ستُرسم فعلًا.

٣

فتقف السطور على شبكة الأساس بفارق أقل من جزء من مئة من النقطة.

العمود في هذا الكتاب ضيّق عمدًا، نحو خمس كلمات في السطر، وهو قياس تسمح به الفقرة العربية لقصر كلمتها المتوسطة عن اللاتينية. والصفحة عمودان، يمتلئ الأيمن قبل الأيسر، وتقع الحافة المشرشرة على اليسار حيث ينتهي البصر لا حيث يبدأ.

Plate 12. Measured, shaped, right to left. From THE GRID (Arabic), seed shabaka-1.

The SVG conventions

The SVG output is self-contained. Duotone treatment is performed with feColorMatrix inside the file. Clip paths carry unique ids so that two plates pasted into one page do not clip one another's pictures, an accident this manual regards as beneath discussion. With embed, registerFontFile carries the face itself into the output, so the file renders identically on a machine that has never heard of the font. (Plate 12)

The DOM renderer

The DOM renderer sets live text. The reader may select it, copy it, and search it. This is a courtesy the SVG file cannot extend and the DOM renderer must therefore extend perfectly: the live text sits on the same baselines, to the same measure, as the composed page dictates. The worst measured deviation is 0.013 pixels. The typical deviation is 0.002. We publish these numbers because the next section explains why we are entitled to them.

The doctrine of measurement

Nothing is computed that can be measured. This is the standing doctrine of the rendering layer and the reader should treat it as such. Font metrics, as reported, describe a font. They do not describe what a particular browser did with that font at a particular fractional size on a particular afternoon. Browsers quantize. Metrics files do not know this. The renderer therefore places a hidden probe into the document, sets a glyph, and measures where the baseline actually landed. The measured value is used. The computed value is not consulted.

The 0.505 pixel incident

The doctrine was not always in force. In an earlier state of the library the baseline was computed from font metrics, and every line on every page landed 0.505 pixels from where it belonged. The error was constant, invisible in isolation, and cumulative in effect: every rule, every figure edge, every caption sat a half pixel off the register it claimed to honour. This manual records the episode with regret. A register that is wrong by a constant is wrong. The baseline is now measured by the probe, and the numbers of the preceding section are the result.

useBrowserFonts

Where the composition must agree with what a browser will draw, useBrowserFonts measures the fonts through canvas. The advance widths used by the line breaker are then the advance widths the browser will use, and the paragraph that was composed is the paragraph that appears. The alternative, composing against one set of widths and rendering against another, produces lines that are almost correct, and almost correct lines are the signature of systems that trusted a table.

registerFontFile

registerFontFile turns any TTF, OTF, or WOFF into a measurable font in one call. It reads the file through the optional peer opentype.js and, from the face's PANOSE classification, chooses the appropriate CSS fallback stack, so that a document degrades toward a relative rather than a stranger. One call. The manual sees no reason a font should require more ceremony than a paragraph.

Optional peers and the zero-dependency rule

The core carries zero runtime dependencies. This is a rule, and it stands. opentype.js is an optional peer for font registration. hyphen is an optional peer for Liang's TeX hyphenation patterns. pretext is an optional peer that accelerates greedy breaking by about thirty times with line-for-line agreement, verified by an included eval script. Each peer extends the library. None is required by it. A composition system that cannot compose without its accessories has confused itself with its accessories.

9 THE PROGRAMME LAYER

The founding instruction
Gerstner's thesis is the founding instruction of this layer and we restate it in his spirit: the designer's task is to describe the programme and let the programme produce the solutions. A grid, correctly specified, is the set of all layouts that obey it. The programme layer exists to make that set addressable. The designer states constraints. The machine enumerates what satisfies them. Taste, which Chapter 10 will formalise, selects among the survivors.

The constraints DSL
Constraints are written in a small DSL over grids. The vocabulary is deliberately narrow, because Chapter 3 has already established that the grid admits no off-grid position and the DSL inherits that austerity. A constraint names what must hold. It does not suggest. The solver beneath the DSL is an exhaustive backtracking solver: it visits the space of placements, prunes what violates a constraint, and returns solutions that are correct by construction. A solution from this layer does not need to be checked. It needs to be looked at. (Plate 13)

The sampling discipline
When the space of solutions exceeds the pool, the solver samples. The manual must here relate a failure. An earlier implementation drew its pool as a truncated depth-first prefix of the search tree. The prefix was deterministic, and it was also a prefix: across 20,000 pooled solutions, certain item placements never varied, because the truncation fell before the branches that would have moved them. The pool was large and it was unrepresentative. The remedy is seeded randomised restarts. Each restart enters the tree at a seeded angle, and the pool now covers the space it claims to sample. The reader designing a solver is invited to learn this at our expense rather than at theirs.

layout(seed) and locks
The working interface is layout(seed). A seed produces a layout from the pool, deterministically and forever, per the doctrine of Chapter 10. reroll produces another. Elements the designer wishes to keep are locked, and the reroll then varies only what remains free. This is the correct division of labour: the machine proposes within the constraints, the designer fixes what has become right, and the space contracts around the fixed points until a page remains.

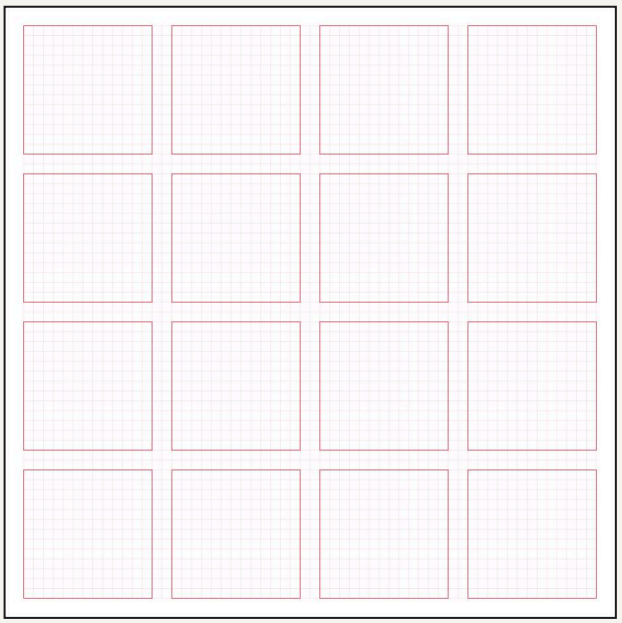


Plate 13. The mobile grid at 58 units, computed. After KG pp.58-61.

The mobile grid and the number 58
Gerstner's mobile grid admits simultaneous divisions of one square area. The least area that takes every division from one through six with a two-unit gutter is 58 units, and the library computes this through gerstnerNumber rather than reciting it, because a constant that could have been a function is a small dishonesty. Fifty-eight is a modest number. It is, as Gerstner demonstrated, a sufficient one.

The morphological box
The morphological box (KG p.59) is treated by this layer as an enumerable parameter space: axes of variation, each with discrete values, whose Cartesian product is the space of designs. The box is a data structure here. The programme layer walks it, the constraints prune it, the seed indexes into what survives. Gerstner drew the box by hand and filled its cells by judgement. We have mechanised the walking and left the judgement where it was.

10 ON DETERMINISM AND TASTE

Seeds
A seed is a string. The reader may use a word, a date, a sentence, or the name of a client. Rand(seed) hashes the string through xmur3 and feeds the resulting state to sfc32, and we name these functions the way an engineer names the machinery in a plant room, because that is what they are: the hash that seats the state and the generator that turns it over. Every random decision in the library, from the beam's tie-breaks to the per-page figure dispositions to the programme layer's restart angles, draws from this stream and from no other source.

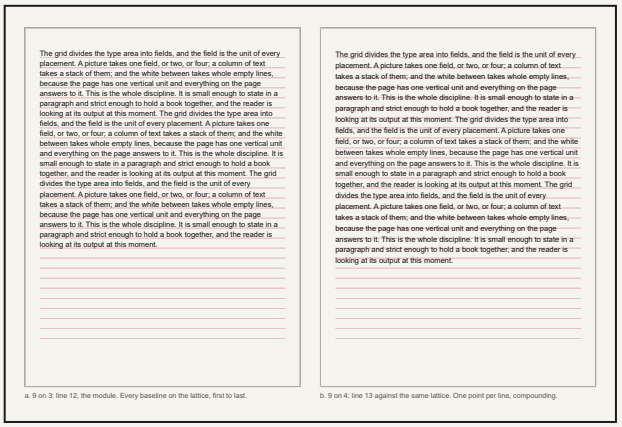
The guarantee
Same seed, same book, forever. There is no version of this guarantee with conditions attached and the manual will not manufacture one. No clock is read. No machine identity is consulted. The composed book of a given seed on a given input is a mathematical object, and it can be reproduced next year, on other hardware, by other hands, page for page. Where behaviour changes between releases, the release notes say so, because a silent change to determinism is a broken promise with good manners.

Taste as a disclosure requirement
The beam that places figures is scored by harmony weights: newSize 1.2, sameBand 1.0, sharedEdge 0.35, stacked 0.25, adrift 0.8, with anchorPull 0.45 measured from the figure's centre. This small object of named numbers is the taste of the system, and the manual's position is that publishing it is a disclosure requirement. Every layout engine has preferences. Most keep them in the walls. Ours are printed in the specification, may be overridden, and appear in this chapter so that the reader knows precisely whose judgement is operating when a picture settles where it does. Preferences with weights can be argued with. Laws in the walls cannot.

The beam is a search
The beam finds good pages. It does not claim the best page. The space of placements is large, the beam is finite, and a system that announced optimality over a space it had not exhausted would be reporting a feeling. The report of Chapter 7 states what was achieved and the weights above state what was sought. The reader may inspect both.

11 THE UNIT, DEMONSTRATED

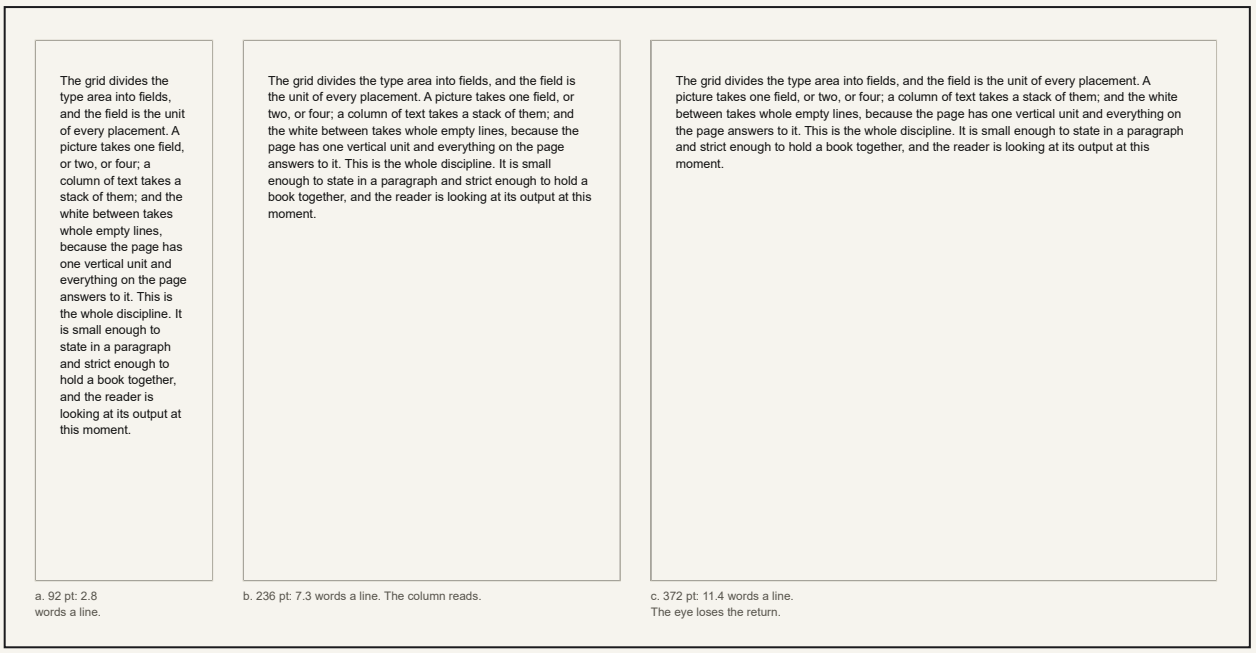
The chapters above state the law; the chapters that follow enter the evidence. Every plate in this part was composed by the library at the moment this copy of the manual was composed, from the seed on the colophon. None is an illustration in the decorative sense. Each is the output of the rule it stands beside, and if the rule were removed from the library the plate would change or refuse to exist. The reader who distrusts a claim is invited to distrust the plate, recompose, and watch the plate come back. The demonstrations run from page 20 to page 27; the commissions, with their programmes printed whole, begin on page 34.



Demonstration 1. One paragraph, one 12 point lattice, two leadings. The lattice is drawn by the renderer; the drift is drawn by the arithmetic. The type system refuses setting b at construction.

One leading, one point, one page of drift

The register is not a preference about neatness; it is arithmetic, and arithmetic compounds. Demonstration 1 sets the same paragraph twice against the same 12 point lattice: once at 9 on 3, where the line height equals the module and every baseline lands on a lattice line from the first to the last, and once at 9 on 4, one point over, where the first baseline lands true and every line after it adds a



Demonstration 2. One paragraph at 9 point across three measures. sizeForMeasure(236) answers: 8 on 2, 8.2 words a line, within the canon.

point of error (Demonstration 1). Nothing about the second setting looks wrong at line two. By the foot of the column it is adrift by more than a whole line, and a second column set beside it would shear against it visibly. This is why the type system refuses an off-module role at construction

rather than warning about it at page time: a one point error is invisible exactly as long as it is cheap to fix.

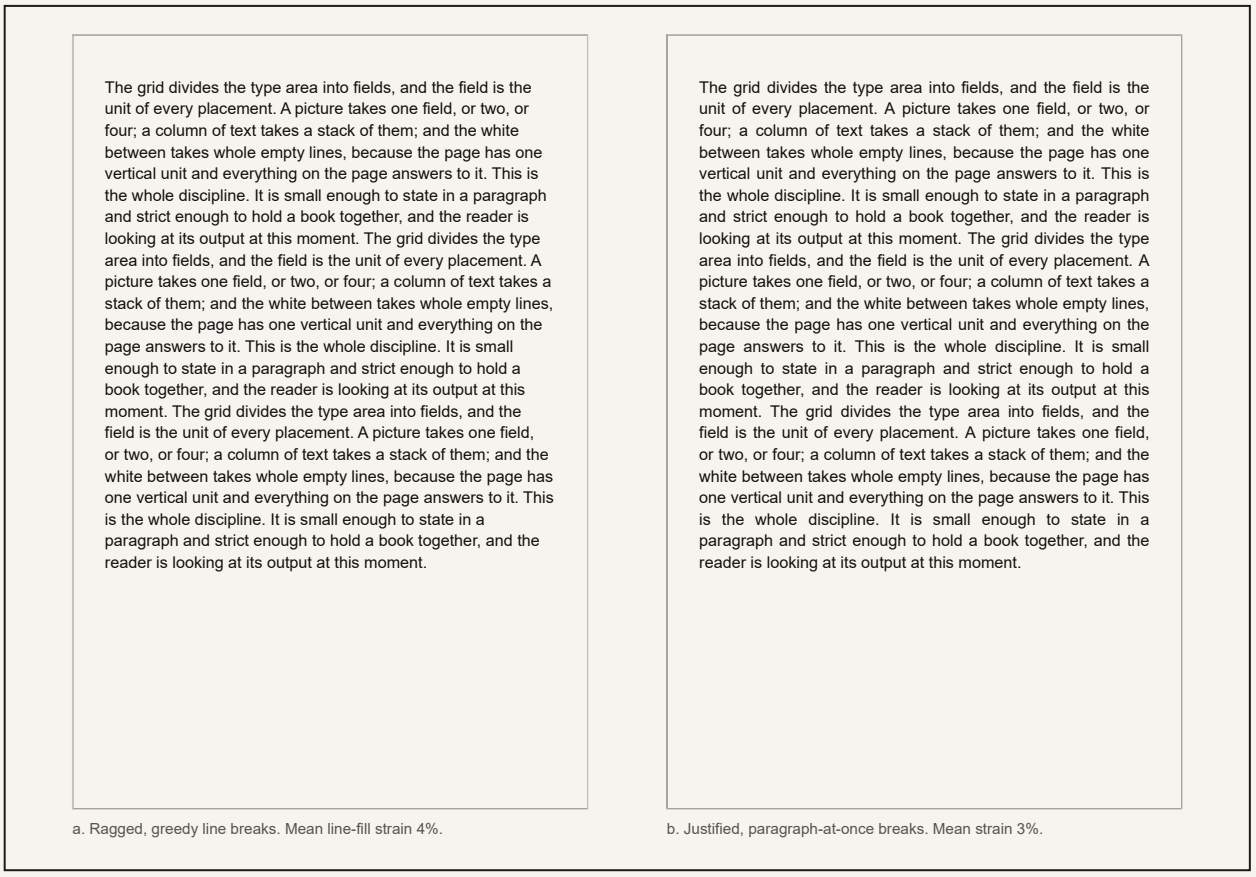
The column decides the face

Chapter 2 stated the dependency: measure first, then size, seven to ten words a line (MB pp.18, 30-31, 57). Demonstration 2 sets one paragraph at one size across three measures (Demonstration 2). In the narrow column the 9 point face manages about four words a line and the setting falls apart into stripes; in the wide column it carries thirteen and the eye loses the return; in the middle column it carries eight and reads. The lesson is directional. The column width is given by the grid, so the face must be chosen to suit it, and sizeForMeasure exists so that the choice is a computation, printed with its words-per-line count, rather than a squint.

12 THE SETTING, DEMONSTRATED

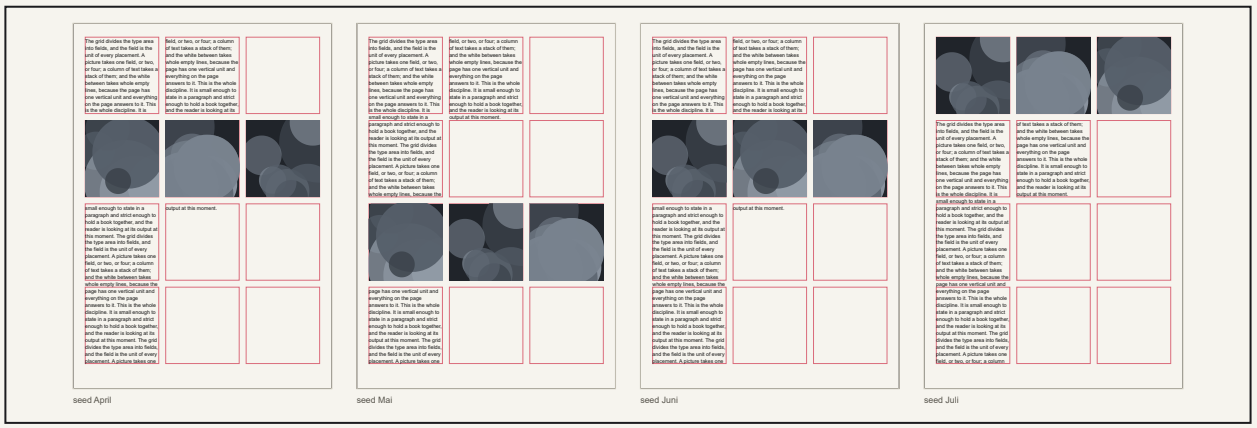
What justification costs, and where the cost goes

A justified column buys two straight edges, and pays for them in word spaces. The only question is whether the payment is spread or dumped. Demonstration 3 sets the same paragraph twice at the same measure (Demonstration 3): once broken greedily, line by line with



Demonstration 3. The same paragraph, ragged and justified, with the strain measured and printed. The elastic limits, 0.55 to 4 of the natural space, bound the worst line in either setting.

no look-ahead, and once by the Knuth-Plass algorithm the library borrows, which breaks the whole paragraph at once and distributes the strain. The mean deviation of the greedy setting's spaces from the natural space is roughly twice that of the paragraph-at-once setting, and the number is printed beneath each column because a typographic argument that will not state its measurements is a mood. The library's elastic limits, 0.55 to 4 times the natural space, bound the worst line in either case; a line that cannot be set within them is left ragged, which is a report, not a failure.



Demonstration 4. One commission, four seeds. Same manuscript, same grid, same graded picture sizes; every page legal, no page the same. The fields are drawn so the placements can be audited.

13 THE SEARCH, DEMONSTRATED

Four seeds, four pages, one law

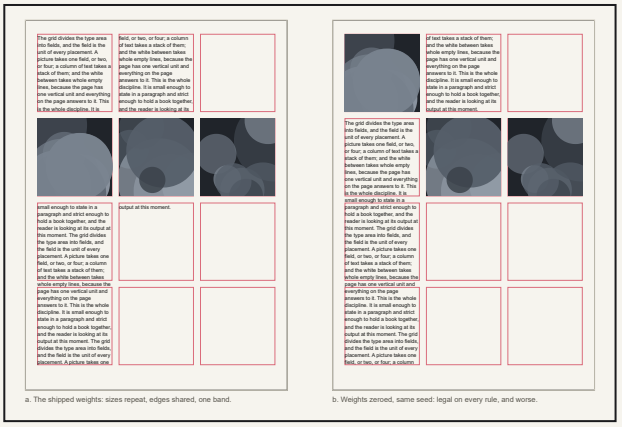
Demonstration 4 composes one small page four times, changing nothing but the seed (Demonstration 4). The manuscript is the same, the grid is the same, the pictures are the same sizes from the same graded set. The pages differ in everything the rules leave open: which band the pictures sit on, which column the text enters, where the white space pools. This is the entire thesis of the library at panel size. A programme that produced one page would be a layout; a programme that produced arbitrary pages would be noise. The claim defended here is the middle one: the seeds walk a space whose every point is legal, and the reader may hold all four pages to every rule in Part One.

The weights are load-bearing

Chapter 8 published the harmony weights and called them the taste of the system. Demonstration 5 removes them (Demonstration 5). The left page is composed under the shipped weights; the right page is the same commission with every relational cost set to zero, so that the beam scores placements only by their distance from the anchor. The right page is legal. Every picture sits in whole fields on the register; nothing overlaps; a rule-checker would pass it. It is also visibly worse: sizes multiply, pictures relate to nothing, the page has no bands. This is the strongest available argument that the weights do work: not that removing them breaks the rules, but that removing them keeps the rules and loses the page.

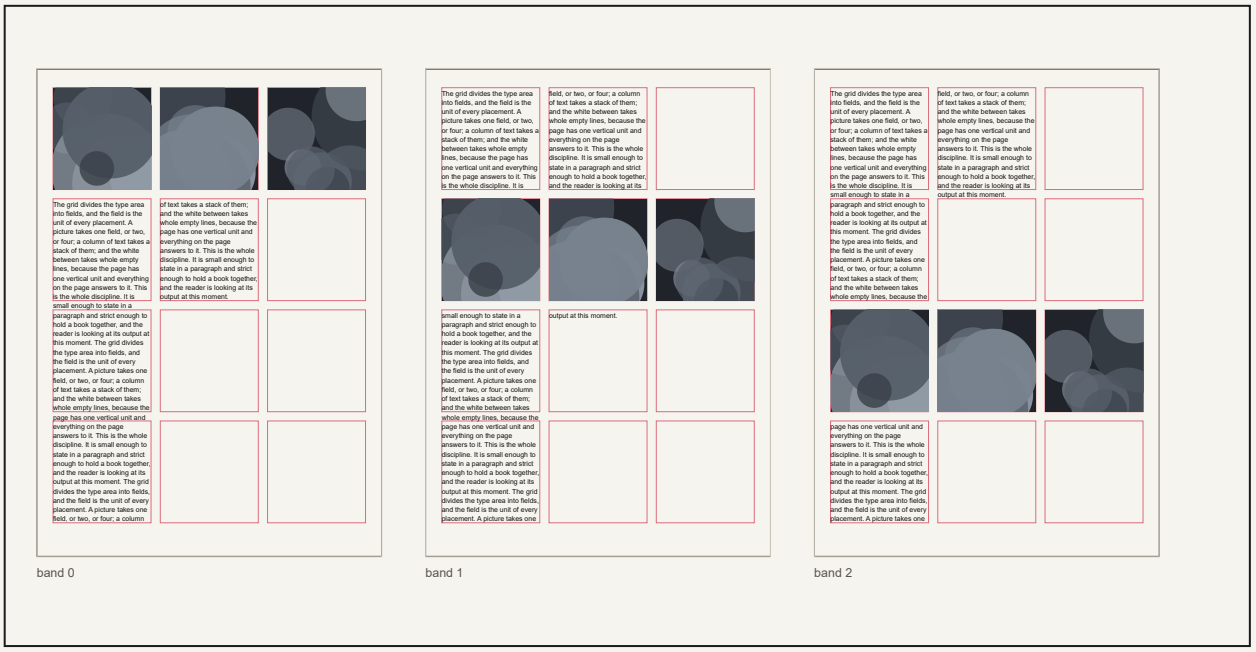
The disposition is a decision, made once

Demonstration 6 composes the same page three times with the band choice pinned: pictures on the top band, the middle band, the foot band (Demonstration 6). In ordinary



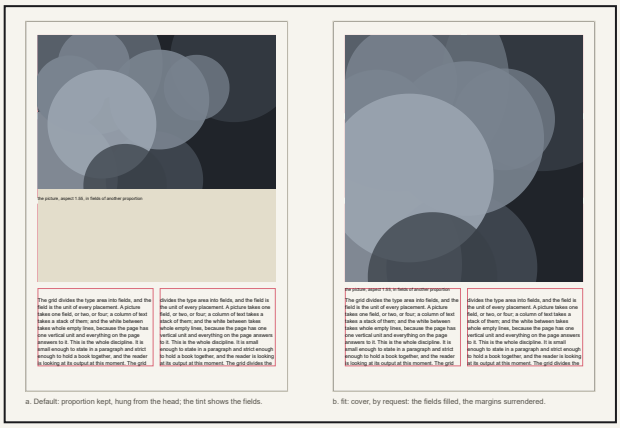
Demonstration 5. The relational weights removed, nothing else changed. The right page passes every hard rule and fails the eye, which is the argument for publishing the weights instead of hiding them.

composition the seed draws this disposition once per page and the beam pulls placements toward it; here the draw is forced so the pull is visible. The point is architectural. Variety in this library does not come from loosening the rules; it comes from a small set of page-level decisions, made before any picture is placed, that the rules then serve. Coherence per page, variety across pages.



Demonstration 6. The page-level band choice forced to the top, middle, and foot. In composition the seed draws this once per page; the beam then serves the decision.

14 THE PICTURE, DEMONSTRATED



Demonstration 7. A picture of aspect 1.55 in fields that do not share it. The default keeps the picture whole and lets the caption follow its true edge; the crop must be asked for in the source.

The crop is a confession

A picture placed into fields that do not share its proportions must lose material or keep it. Demonstration 7 shows both policies on the same commission (Demonstration 7): on the left the default, in which the picture keeps its aspect, hangs from the head of its fields at full width, and its caption follows its true edge; on the right the opt-in, fit set to cover, in which the picture fills the fields exactly and surrenders its margins to the crop. The default is the law stated in Chapter 6 and it exists because of what this manual's plates are: pages. A cropped photograph is a photograph; a cropped page is a misquotation. Cover remains available for material that can afford it, and asking for it in the source is the confession the law requires.

Demonstration 8. A statistic drawn under the baseline lattice. Each bar ends on a line because the chart item quantises to the unit; the audit is visual and takes one glance per bar.

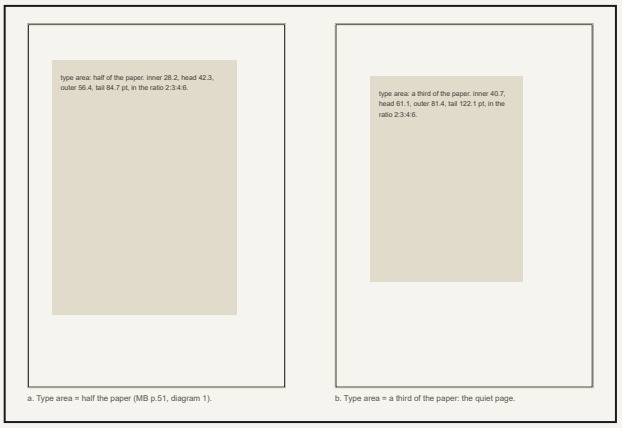
A chart is text that learned to stand up

Demonstration 8 draws a statistic under the baseline lattice (Demonstration 8). Every bar is a whole number of text lines tall, by construction rather than by rounding: the chart item quantises its values to the line and prints beside prose without a seam, because bar and body answer to the same unit (MB pp.14, 58-59). The lattice is drawn through the panel so the reader can audit the claim bar by bar. A chart whose bars land between lines would be a picture of numbers; this one is typography.

15 THE MARGIN, DEMONSTRATED

The white is specified

Margins in this library are not the leftover after content; they are set first, and two constructions from the canon are drawn in Demonstration 9 (Demonstration 9). The first gives the type area half the paper's area, the second a third, both with margins in the advisory proportions in



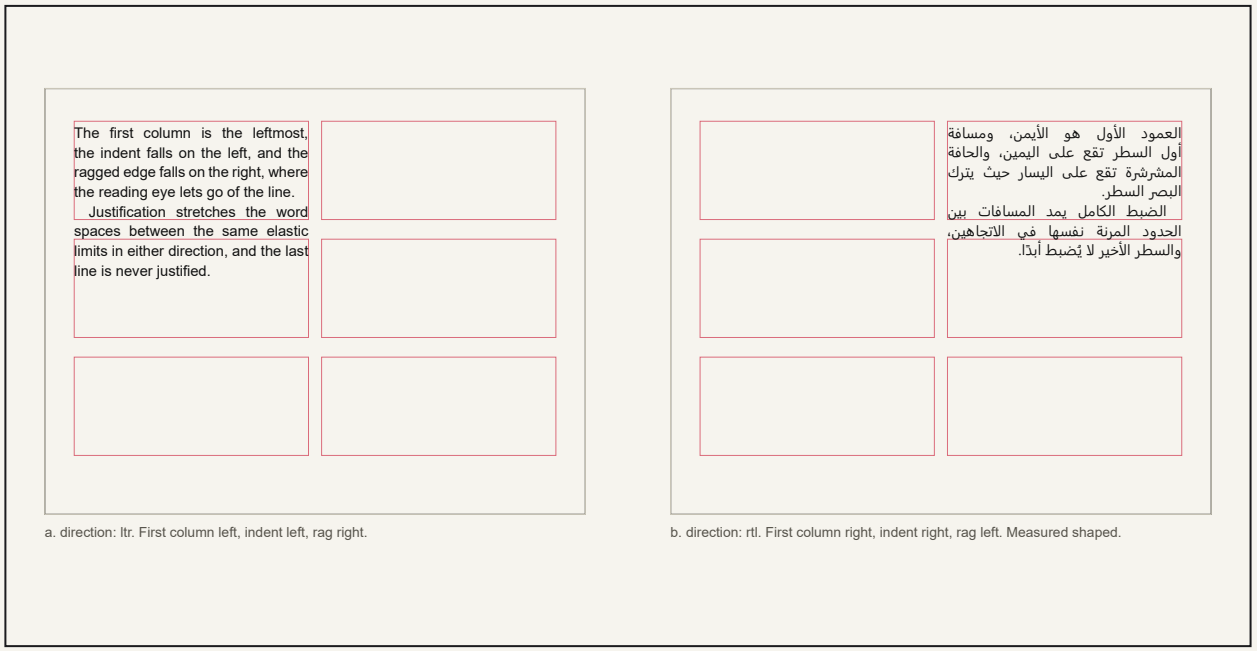
Demonstration 9. marginsForAreaFraction solves the margins so the type area takes an exact fraction of the paper, in advisory proportions: inner narrowest, tail deepest, the mass floating high.

which the inner margin is narrowest, the head next, and the tail deepest, so the type area floats high and the page does not look as though its contents were about to fall out of it (MB p.51). The construction is printed with its arithmetic because marginsForAreaFraction is a function, and a function's output belongs in its documentation.

16 THE DIRECTION, DEMONSTRATED

The mirror is exact

Demonstration 10 sets a short passage twice: Latin left to right, Arabic right to left (Demonstration 10). Under direction rtl the first column is the rightmost, the first-line indent falls on the right, the ragged edge falls on the left, and justification stretches the same elastic spaces

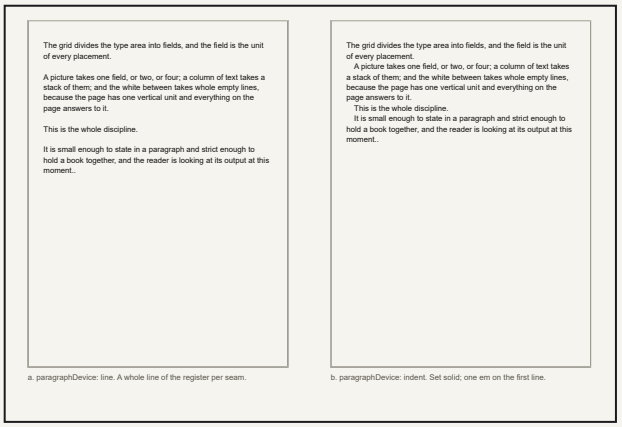


a. direction: ltr. First column left, indent left, rag right.

b. direction: rtl. First column right, indent right, rag left. Measured shaped.

Demonstration 10. The same rules read in the other direction. Columns, indents, ragged edges, and justification mirror exactly; nothing else in the library changes.

between the same limits. Nothing else changes, and that is the demonstration: direction in this library is a reading order, not a second engine. The Arabic is measured shaped, in a real browser, because the width of a joined word is a property of its drawn form and of nothing else.

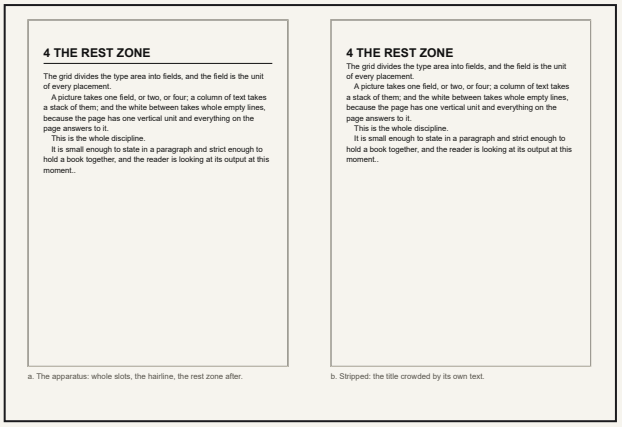


a. paragraphDevice: line. A whole line of the register per seam.

b. paragraphDevice: indent. Set solid; one em on the first line.

Demonstration 11. The same paragraphs under the two devices of MB p.34. The seam costs a whole line or an em; the option chooses which, and no option buys a half line.

17 THE APPARATUS, DEMONSTRATED



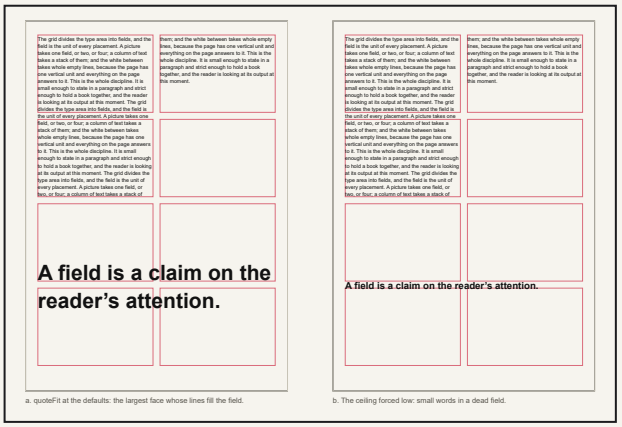
a. The apparatus: whole slots, the hairline, the rest zone after.

b. Stripped: the title crowded by its own text.

Demonstration 12. One chapter opening, dressed and stripped. The rest zone is specified in whole lines (MB pp.69-70), because every pause on the page is.

The paragraph announces itself

Müller-Brockmann names the lawful ways a paragraph may declare its own beginning: the empty line, the indented first line, the initial (MB p.34). Demonstration 11 sets the same three paragraphs under the first two devices (Demonstration 11). Under the empty line the page spends a whole line of its register on each seam and reads airily; under the indent the paragraphs set solid and the seam costs one em of the first line. Neither is free and neither is wrong; the option is paragraphDevice, and the indent's



a. quoteFit at the defaults: the largest face whose lines fill the field.

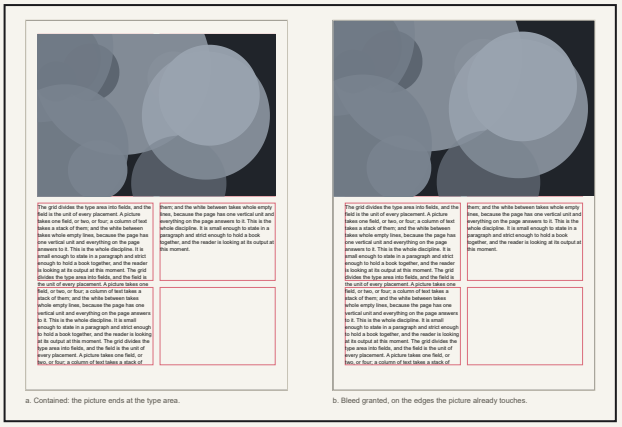
b. The ceiling forced low: small words in a dead field.

Demonstration 13. A pull quote occupies fields as a picture does, and must fill them. The right panel is the naive result the fitting exists to prevent.

em is itself an option, defaulting to the body size. What is not offered is a half-line of space, for the reason Part One made structural: there is no such distance on the page.

The title stands on its apparatus

A title is not a large paragraph. It owns a face, whole slots of the register, a hairline if asked, and a rest zone of whole empty lines that gives it its importance (MB pp.46-47, 69-70). Demonstration 12 sets the same chapter opening twice (Demonstration 12): once with its apparatus, the rule



a. Contained: the picture ends at the type area.

b. Bleed granted, on the edges the picture already touches.

Demonstration 14. The one licensed escape from the grid (MB p.39). The license extends an edge already reached; it never moves a picture to one.

under the line and the rest zone after it, and once stripped, the title crowded by its own text at the ordinary line spacing. The stripped version wastes nothing and says nothing. The rest zone is the typographic equivalent of pausing before speaking, and it is specified in whole lines because every pause on this page is.

The quote fills its field

A pull quote occupies grid fields exactly as a picture does, and like a picture it must fill them. Demonstration 13 shows the fitting (Demonstration 13): on the left the library's sizing, the largest face whose broken lines fill the field, centred on whole lines; on the right the same quote with the fitting ceiling forced low, so the words sit small in the top corner of a dead field. The right panel is what a naive implementation produces and what quoteFit exists to prevent: a field is a claim on the reader's attention, and a claim half-occupied is half-retracted.

The bleed is licensed, not taken

A picture that reaches the edge of the type area may be carried off the edge of the paper; MB reserves the device for plates that must be monumental (p.39), and the library grants it only on the sides the picture already touches. Demonstration 14 composes the same commission twice (Demonstration 14): once contained, once with bleed granted, the picture running through the margin to the trim. The rule to notice is the license's condition. A picture in the middle of the page asking to bleed is refused by geometry, because bleed in this library is an extension of an edge already reached, never a teleport to one.

18 THE ERRORS, QUOTED

A library's error messages are its posture under stress, and this one was written to teach at the moment of refusal. The messages below are quoted verbatim; each is thrown before any page exists, because the cheapest place to catch a typographic error is prior to typography.[1]

The register refused
Ask the type system for a role whose line height misses the module and it answers with the two nearest settings that do not:

```
Type system breaks baseline register: head: line
height 18pt (10pt + 8pt) does not register with the 8pt
module. Every distance on the page is a multiple of one
module, so line heights must divide it or be divided
by it (MB pp.59, 66). Nearest legal settings for 10pt:
10/6 (line 16), 10/14 (line 24).
```

The error happened, in this exact form, to the author of this manual while setting the Arabic essay on the shelf, and the correction it named is the one the published book uses. The manual reports this as a satisfied customer.

The geometry refused
A grid whose type area cannot hold its rows in whole lines is refused at construction:

```
Type area too shallow for 8 field rows at 12pt lines
```

There is no partial acceptance and no silent shrinking of the demand. The caller asked for eight rows; the page can honestly hold fewer; the library declines to pretend otherwise and says how the demand and the page disagree.

The citizenship refused
A figure whose anchor does not occur in the story is an orphan, and orphans are refused before placement:

```
Figure plate-3: anchor "(Plate 3)" not found in story
```

The anchor is the figure's citizenship in the text. A picture that cannot say which sentence it belongs to would be placed by accident and would travel when the text reflows; the library prefers the author find out at compose time, in one line, with the figure named.

[1] Quoted from the very build of the library that composed this copy; if the wording changes, this page changes with it.

And the margin won. The lawyers of Europe had an adage about it, and they meant it literally: whatever the Gloss does not recognise, the court does not recognise. What had been set aside as emptiness became the site of the work, and the work at the centre became, formally, the seed of a pearl. No modern art director would dare the layout. The glossators had been doing it for four hundred years.

II. THE MARGIN WAS TOO NARROW

In about 1637, Pierre de Fermat was reading a Latin edition of Diophantus, and beside the eighth problem of the second book he wrote a note in the margin. He had discovered, he said, a truly marvellous proof that no cube can be written as the sum of two cubes, nor any higher power; and then —the most famous sentence ever written in a margin —this margin is too narrow to contain it (Plate 3).

He never wrote it anywhere else. His son found the note after his death and printed it in the margin of the next edition, which is the only reason the world has it at all (Plate 4). For three hundred and fifty-seven years the sentence sat there, sneering, until Andrew Wiles closed it in 1994 with a proof that runs to a hundred and thirty pages and uses mathematics that did not exist in the seventeenth century. Nobody now believes Fermat had it. Everybody believes he thought he did.

What interests me is not the theorem. It is the sentence: the margin is too narrow. A man with a full page of blank paper on his desk chose to record the most consequential claim of his life in the smallest available space, and then blamed the space. The margin invites a particular kind of writing —brief, unguarded, unedited, addressed to nobody —and it gets, in return, exactly what its size deserves. Give a reader a hand's width of emptiness beside an argument and you will get an argument back. Give them two centimetres and you will get a shout.

III. THE LICENSED EDGE

Now a structural observation, which the notebooks of engineers demonstrate bet-

hunc marginis exiguitas non capieret

5

Case 1. margin/margin-04.svg · seed margin-1

The Margin

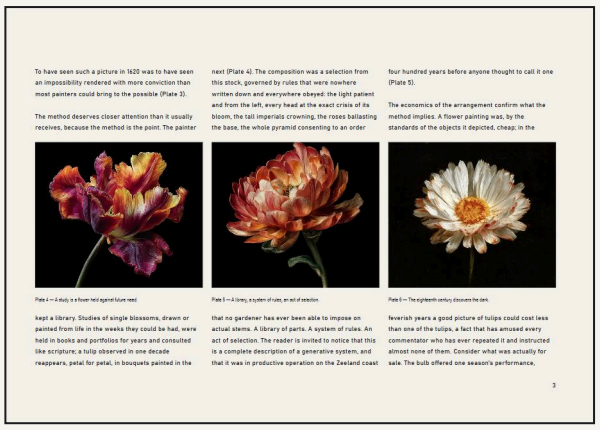
A square book made to exercise the difficult things at once: pull quotes occupying grid fields, rotated marginal text, justified setting, dropped initials with derived wells (Case 1). Its proof is coexistence: each device is easy alone and the page holds all of them on one register.

The Numeral

The first book set with the full title apparatus: chapter numerals on three lines, titles over hairlines, italic subtitles, bold heads, in a face with old-style figures (Case 2). Its proof is the register across sizes: five roles, one module, no baseline broken.

The Centering

An all-DIN book with a marginal caption column, signal numerals, duotone plates, and bleeds (Case 3). Its proof



To have seen such a picture in 1620 was to have seen an impossibility rendered with more conviction than most painters could bring to the possible (Plate 3).

The method deserves closer attention than it usually receives, because the method is the point. The painter kept a library. Studies of single blossoms, drawn or painted from life in the weeks they could be had, were held in books and portfolios for years and consulted like scripture; a tulip observed in one decade reappears, petal for petal, in bouquets painted in the next (Plate 4). The composition was a selection from this stock, governed by rules that were nowhere written down and everywhere obeyed: the light patient and from the left, every head at the exact crisis of its bloom, the tall imperials crowning, the roses ballasting the base, the whole pyramid consenting to an order that no gardener has ever been able to impose on actual stems. A library of parts. A system of rules. An act of selection. The reader is invited to notice that this is a complete description of a generative system, and that it was in productive operation on the Zeeland coast four hundred years before anyone thought to call it one (Plate 5).

The economics of the arrangement confirm what the method implies. A flower painting was, by the standards of the objects it depicted, cheap; in the feverish years a good picture of tulips could cost less than one of the tulips, a fact that has amused every commentator who has ever repeated it and instructed almost none of them. Consider what was actually for sale. The bulb offered one season's performance,

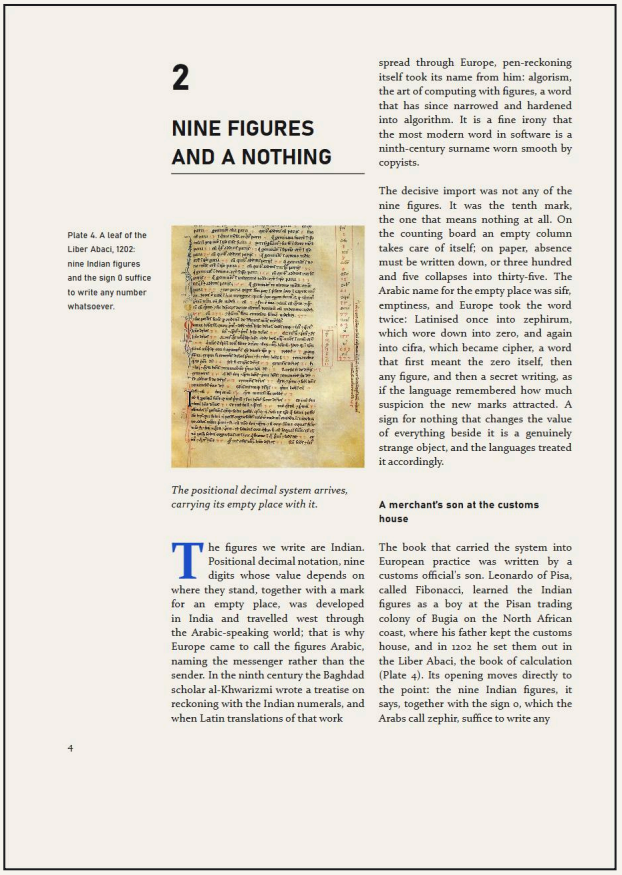
Plate 4 — A study in a flower held against future need.

Plate 5 — A library, a system of rules, an act of selection.

Plate 6 — The eighteenth century discovers the dark.

3

Case 6. book/essayB-02.svg · seed stilleven-essay-1



2

NINE FIGURES AND A NOTHING

Plate 4. A leaf of the Liber Abaci, 1202: nine Indian figures and the sign 0 suffice to write any number whatsoever.

The positional decimal system arrives, carrying its empty place with it.

The figures we write are Indian. Positional decimal notation, nine digits whose value depends on where they stand, together with a mark for an empty place, was developed in India and travelled west through the Arabic-speaking world; that is why Europe came to call the figures Arabic, naming the messenger rather than the sender. In the ninth century the Baghdad scholar al-Khwarizmi wrote a treatise on reckoning with the Indian numerals, and when Latin translations of that work spread through Europe, pen-reckoning itself took its name from him: algorism, the art of computing with figures, a word that has since narrowed and hardened into algorithm. It is a fine irony that the most modern word in software is a ninth-century surname worn smooth by copyists.

The decisive import was not any of the nine figures. It was the tenth mark, the one that means nothing at all. On the counting board an empty column takes care of itself; on paper, absence must be written down, or three hundred and five collapses into thirty-five. The Arabic name for the empty place was sifr, emptiness, and Europe took the word twice: Latinised once into zephirum, which wore down into zero, and again into cifra, which became cipher, a word that first meant the zero itself, then any figure, and then a secret writing, as if the language remembered how much suspicion the new marks attracted. A sign for nothing that changes the value of everything beside it is a genuinely strange object, and the languages treated it accordingly.

A merchant's son at the customs house

The book that carried the system into European practice was written by a customs official's son. Leonardo of Pisa, called Fibonacci, learned the Indian figures as a boy at the Pisan trading colony of Bugia on the North African coast, where his father kept the customs house, and in 1202 he set them out in the Liber Abaci, the book of calculation (Plate 4). Its opening moves directly to the point: the nine Indian figures, it says, together with the sign 0, which the Arabs call zephir, suffice to write any

4

Case 2. numeral/numeral-03.svg · seed numeral-3

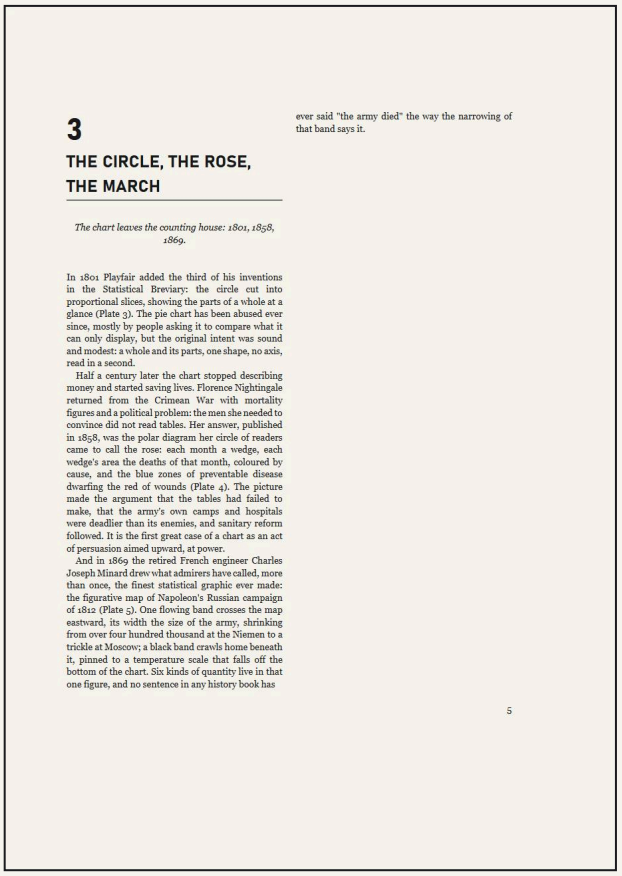
is the caption canon: captions beside their pictures, top edges level, never printing over one another.

19 NINE BOOKS, NINE PROOFS

The library's shelf is its evidence locker, and each volume on it was composed to prove a capability under load. One page of each is entered here, with the claim it carries. Every seed is on record and every book can be recomposed from it.

Against Tables
An essay on statistical drawing whose charts are drawn by the library, bars a whole number of text lines tall, charting the book's own body (Case 4). Its proof is the chart item as a grid citizen, demonstrated at book length rather than panel length.

Stilleven
Twenty plates of Dutch flower pieces on a dark ground, drop caps, marginal captions, widow control (Case 5). Its proof is the beam under pressure: many pictures, few sizes, pages that hold together for forty leaves.

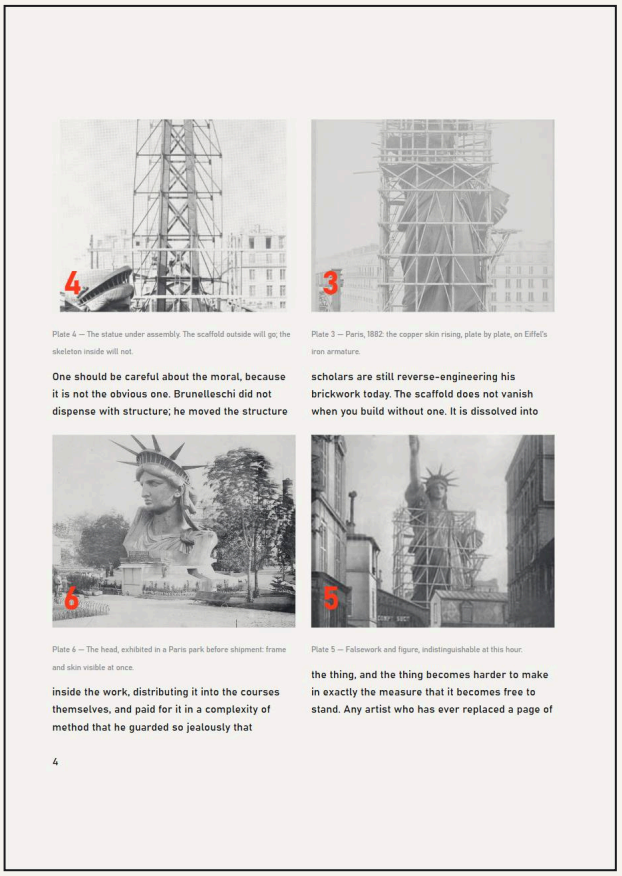

3
THE CIRCLE, THE ROSE, THE MARCH
The chart leaves the counting house: 1801, 1858, 1869.
In 1801 Playfair added the third of his inventions in the Statistical Breviary: the circle cut into proportional slices, showing the parts of a whole at a glance (Plate 3). The pie chart has been abused ever since, mostly by people asking it to compare what it can only display, but the original intent was sound and modest: a whole and its parts, one shape, no axis, read in a second.
Half a century later the chart stopped describing money and started saving lives. Florence Nightingale returned from the Crimean War with mortality figures and a political problem: the men she needed to convince did not read tables. Her answer, published in 1858, was the polar diagram her circle of readers came to call the rose: each month a wedge, each wedge's area the deaths of that month, coloured by cause, and the blue zones of preventable disease dwarfing the red of wounds (Plate 4). The picture made the argument that the tables had failed to make, that the army's own camps and hospitals were deadlier than its enemies, and sanitary reform followed. It is the first great case of a chart as an act of persuasion aimed upward, at power.
And in 1869 the retired French engineer Charles Joseph Minard drew what admirers have called, more than once, the finest statistical graphic ever made: the figurative map of Napoleon's Russian campaign of 1812 (Plate 5). One flowing band crosses the map eastward, its width the size of the army, shrinking from over four hundred thousand at the Niemen to a trickle at Moscow; a black band crawls home beneath it, pinned to a temperature scale that falls off the bottom of the chart. Six kinds of quantity live in that one figure, and no sentence in any history book has ever said "the army died" the way the narrowing of that band says it.
5

Case 4. charts/charts-04.svg · seed tables-1

Stilleven, edition B
The same manuscript and the same pictures on a landscape grid in another face (Case 6). Its proof is the thesis of the whole library: one argument, two typographies, no hand-work between them. The words did not change; the programme did.

The Field
An essay on where the grid came from, illustrated by grids the library drew about itself (Case 7). Its proof is self-reference done soberly: the plates are outputs of the machinery the prose describes, which is the method this manual's Part Two adopted.

The Dot and the Grid
The Arabic essay: right-to-left composition, measured shaped in a real browser, folios in Arabic-Indic numerals, plates from the manuscript tradition (Case 8). Its proof is direction as a first-class option, and it found and fixed the caption's bidi conduct on the way, which is what proofs are for.


4
Plate 4 — The statue under assembly. The scaffold outside will go; the skeleton inside will not.
One should be careful about the moral, because it is not the obvious one. Brunelleschi did not dispense with structure; he moved the structure
3
Plate 3 — Paris, 1882: the copper skin rising, plate by plate, on Eiffel's iron armature.
scholars are still reverse-engineering his brickwork today. The scaffold does not vanish when you build without one. It is dissolved into
6
Plate 6 — The head, exhibited in a Paris park before shipment: frame and skin visible at once.
inside the work, distributing it into the courses themselves, and paid for it in a complexity of method that he guarded so jealously that
5
Plate 5 — Falsework and figure, indistinguishable at this hour.
the thing, and the thing becomes harder to make in exactly the measure that it becomes free to stand. Any artist who has ever replaced a page of
4

Case 3. centering/modern-03.svg · seed centering-modern

Bauhaus
The bilingual book: German on the left half of every sheet, English on the right, one register for both, chapters resynchronising on fresh leaves (Case 9). Its proof is the construction of the book this library is built from, reproduced by composition rather than homage.

Case 7. THE FIELD, the title leaf, with its strip of field plates · seed seed-7

Case 5. book/essay-03.svg · seed stilleven-essay-1

20 SIX COMMISSIONS, SOURCE AND ALL

Documentation that shows results without programmes asks for trust, and documentation that shows programmes without results asks for imagination. This part declines both requests. Each commission below is an ordinary function. The manual prints its source by reading the function object, then calls it and prints the return value beside the listing, so the code and the page cannot disagree: they are one object, read twice. The reader may retype any of them against the interface printed at the back of this volume.[2]

[2] Function.prototype.toString is specified to return the source text of the function; the manual leans on the specification, which is what specifications are for.

٣

الصورة في الحقل

لم تكن الصورة في الكتاب العربي المخطوط حلية تُلصق حيث اتفق، بل كانت تسكن مساحتها سكنى مقصودة. انظر إلى مكتبة الحريري كما رسمها الواسطي سنة ٦٣٤ للهجرة (اللوحة ١): الرفوف نفسها شبكة، حقول صغيرة متساوية تنضّد فيها الكتب كما تنضّد الصور في حقول هذا الكتاب، والمجلس تحتها شريط أفقي يشغل عرض الصفحة كله. الرسّام قسّم قبل أن يرسم.

وفي كتاب الجامع بين العلم والعمل النافع في صناعة الحيل للجزري (اللوحة ٢) تصبح الدقة شرط الفهم لا طلب الجمال: الرسم هنا مواصفة هندسية، فإن زاغ الأنبوب عن موضعه بطل الشرح. صفحات الجزري أقرب أسلاف الرسم التقني، وهي تفهم ما تفهمه كل شبكة: أن للصورة موضعًا صحيحًا واحدًا تحدده وظيفتها في النص، لا ذوق الناسخ.

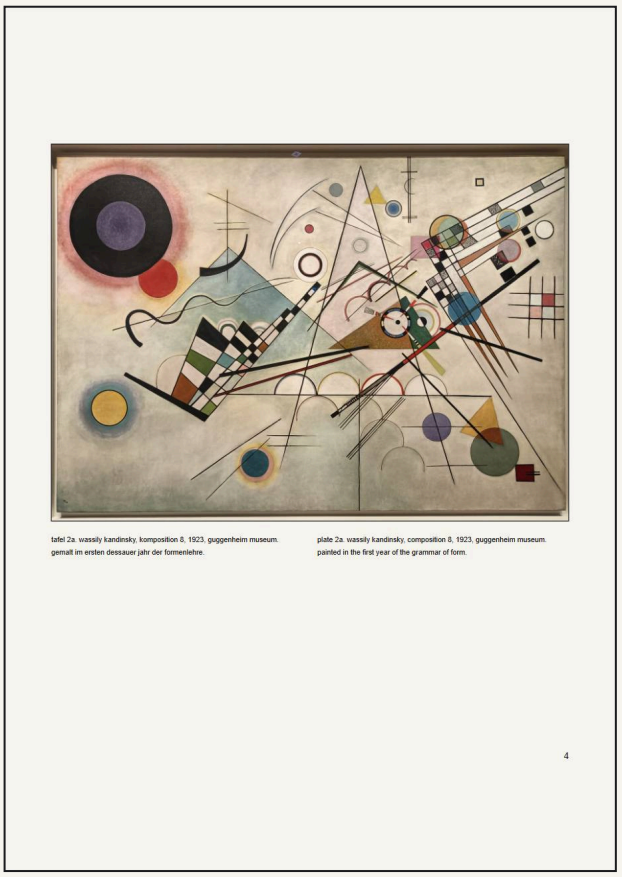
أما عبد الرحمن الصوفي في كتاب صور الكواكب (اللوحة ٣) فيقدّم أعجب درس في الكتاب المصوّر كله: كل كوكبة مرسومة مرتين، مرةً كما تُرى في السماء ومرةً معكوسةً كما تُرى على الكرة

اللوحة ١. مكتبة الحريري بيد يحيى الواسطي، مقامات الحريري، بغداد ٦٣٤ هـ / ١٢٣٧ م. الرفوف شبكة حقول قبل الشبكات.

اللوحة ٢. ساعة الفيل، من كتاب الجزري في الحيل الميكانيكية، نحو ٧١٢ هـ / ١٣١٥ م. الرسم مواصفة، والموضع شرط الفهم.

٤

Case 8. shabaka/shabaka-03.svg · seed shabaka-1



tafel 2a. wassily kandinsky, komposition 8, 1923, guggenheim museum. gemalt im ersten dessauer jahr der formenlehre.

plate 2a. wassily kandinsky, composition 8, 1923, guggenheim museum. painted in the first year of the grammar of form.

4

Case 9. bauhaus/bauhaus-03.svg · seed bauhaus-1

A concert bill

Five items, one grid, no composer (Commission 1). The smallest useful programme: fields taken by coordinates, a display line, a rule, a text block, a red field two rows

```
// a concert bill: one grid, five items, no composer
const g = G.grid({ page: { w: 298, h: 421 },
  margins: { inner: 16, head: 18, outer: 16, tail: 26 },
  columns: 3, columnGutter: 8, line: 10, rows: 5, rowGutterLines: 1 });
return G.renderPage({ grid: g, background: '#f6f4ee', items: [
  { kind: 'block', at: [0, 0, 3, 2], fill: '#c8102e' },
  { kind: 'text', at: [0, 2, 3, 1], text: 'the new music',
    style: G.style(24, 6, { font: 'sans', weight: 'bold' }) },
  { kind: 'rule', at: [0, 3, 2, 1], width: 1.5, color: '#c8102e' },
  { kind: 'text', at: [0, 3, 2, 2], style: G.style(8, 2, { font: 'sans' }),
    text: 'kammerorchester im saal. every distance on this bill is a whole number of ten point lines, including the red field, which is two rows of them.' },
] });
```

Commission 1, the programme. Printed from the function object itself; the plate opposite is its return value.

deep. Everything a poster needs is already in the grid; the composer exists for the pages a poster does not have.

An essay page

The composer at page one (Commission 2). Two columns, a figure anchored to a phrase of its own manuscript, the caption on the picture, justification within the elastic limits, indents for the seams. The manuscript of this page is the paragraph printed on it, which the reader is invited to verify.


The grid divides the type area into fields, and the field is the unit of every placement (Fig. 1). A picture takes one field, or two, or four; a column of text takes a stack of them; and the white between takes whole empty lines. This page was composed by the paragraph you are reading, which is also its manuscript, which is the joke, which is true. The grid divides the type area into fields, and the field is the unit of every placement (Fig. 1). A picture takes one field, or two, or four; a column of text takes a stack of

Fig. 1. One field wide, two deep.

them; and the white between takes whole empty lines. This page was composed by the paragraph you are reading, which is also its manuscript, which is the joke, which is true. The grid divides the type area into fields, and the field is the unit of every placement (Fig. 1). A picture takes one field, or two, or four; a column of text takes a stack of them; and the white between takes whole empty lines. This page was composed by the paragraph you are

reading, which is also its manuscript, which is the joke, which is true.

Commission 2, the result. The composer at work: anchored figure, justified columns, indents, the caption on the picture.


the new music

kammerorchester im saal. every distance on this bill is a whole number of ten point lines, including the red field, which is two rows of them.

Commission 1, the result. A poster is a grid with opinions. The red field is two rows; the rule is placement eight; nothing is nudged.

```
// an essay page: two columns, one anchored figure, one caption
const g = G.grid({ page: { w: 298, h: 421 },
  margins: { inner: 16, head: 18, outer: 16, tail: 24 },
  columns: 2, columnGutter: 8, line: 8, rows: 4, rowGutterLines: 1 });
const body = G.style(6, 2, { font: 'sans' });
const text = 'The grid divides the type area into fields, and the field is ' +
  'the unit of every placement (Fig. 1). A picture takes one field, or two, ' +
  'or four; a column of text takes a stack of them; and the white between ' +
  'takes whole empty lines. This page was composed by the paragraph you are ' +
  'reading, which is also its manuscript, which is the joke, which is true.';
return G.renderPage({ grid: g, background: '#f6f4ee',
  items: G.composeDocument({
    grid: () => g, styles: { body, caption: G.style(5, 3, { font: 'sans' }) },
    story: text + ' ' + text + ' ' + text, seed: 'essay',
    figures: [{ id: 'f1', anchor: '(Fig. 1)', seed: 'fig-one', border: true,
      sizes: [{ cols: 1, rows: 2 }], caption: 'Fig. 1. One field wide, two deep.' }],
    folio: false, bodyAlign: 'justify', paragraphDevice: 'indent',
  }).pages[0].items });
```

Commission 2, the programme. Printed from the function object itself; the plate opposite is its return value.

A chapter opening

The title apparatus, ordered rather than drawn (Commission 3). A numeral role, a chapter role over its hairline, a rest zone of whole lines, and a type system of

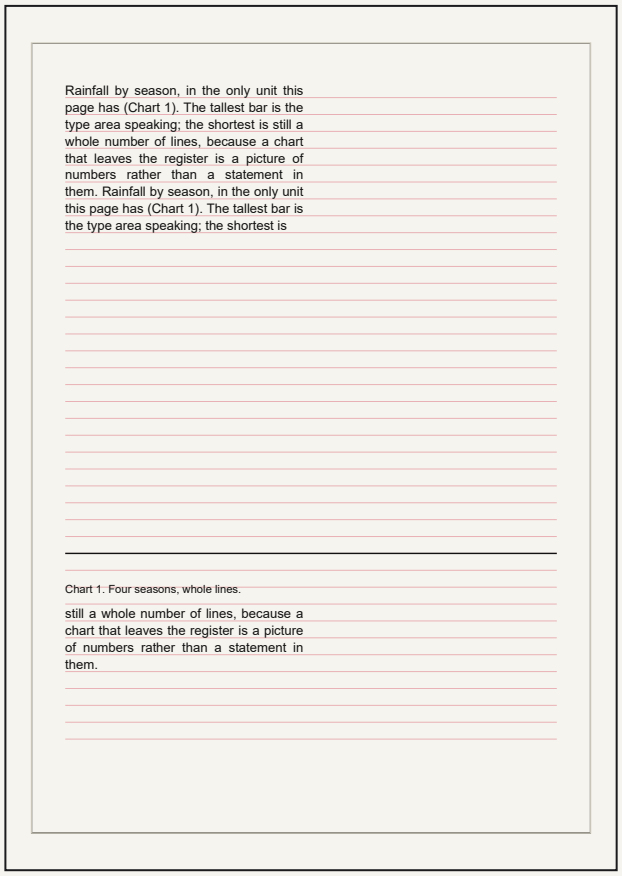
```
// a chapter opening: numeral, title over its rule, rest zone, body
const g = G.grid({ page: { w: 298, h: 421 },
  margins: { inner: 18, head: 20, outer: 18, tail: 26 },
  columns: 2, columnGutter: 8, line: 9, rows: 4, rowGutterLines: 1 });
const T = G.typeSystem({ module: 9, roles: {
  body: G.style(7, 2, { font: 'sans' }),
  numeral: G.style(21, 6, { font: 'sans', weight: 'bold', color: '#c8102e' }),
  chapter: G.style(12, 6, { font: 'sans', weight: 'bold' }),
} }).roles;
const story = [
  { text: '4', role: 'numeral', keepWithNext: true, spaceBefore: false },
  { text: 'THE REST ZONE', role: 'chapter', rule: true, spaceAfter: 2, keepWithNext: true },
  'The module is nine points here, and the numeral, the title, the hairline, ' +
  'and the two empty lines after it all stand on it. Delete the rest zone and ' +
  'the title stops being an event; the manual demonstrated this two chapters ago.',
];
return G.renderPage({ grid: g, background: '#f6f4ee',
  items: G.composeDocument({ grid: () => g, styles: T, story, seed: 'opening',
    folio: false, bodyAlign: 'justify', paragraphDevice: 'indent' }).pages[0].items });
```

Commission 3, the programme. Printed from the function object itself; the plate opposite is its return value.

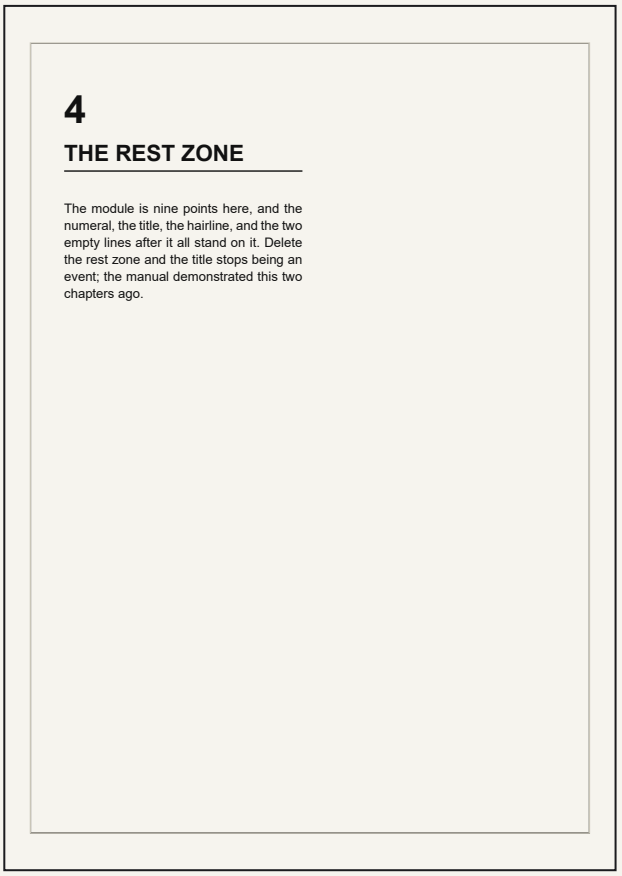
module nine holding all of it to one register. Six lines of programme; the rest is Chapter 5.

A statistic

The chart as a grid citizen (Commission 4). Four values, quantised to whole text lines, drawn on the same lattice as the prose and printed with the baselines showing so the quantisation can be checked by eye.



Commission 4, the result. The chart on the lattice it shares with the prose; the baselines are drawn to be audited.



Commission 3, the result. The title apparatus of Chapter 5, ordered by a six-line programme.

```
// a statistic: bars a whole number of text lines tall
const g = G.grid({ page: { w: 298, h: 421 },
  margins: { inner: 18, head: 20, outer: 18, tail: 26 },
  columns: 2, columnGutter: 8, line: 9, rows: 4, rowGutterLines: 1 });
const body = G.style(7, 2, { font: 'sans' });
const text = 'Rainfall by season, in the only unit this page has (Chart 1). ' +
  'The tallest bar is the type area speaking; the shortest is still a whole ' +
  'number of lines, because a chart that leaves the register is a picture ' +
  'of numbers rather than a statement in them.';
return G.renderPage({ grid: g, background: '#f6f4ee', showBaselines: true,
  items: G.composeDocument({
    grid: () => g, styles: { body, caption: G.style(6, 3, { font: 'sans' }) },
    story: text + ' ' + text, seed: 'rain',
    figures: [{ id: 'c1', anchor: '(Chart 1)', sizes: [{ cols: 2, rows: 2 }],
      chart: { data: [96, 168, 240, 157] }, caption: 'Chart 1. Four seasons, whole lines.' }],
    folio: false, bodyAlign: 'justify', paragraphDevice: 'indent',
  }).pages[0].items });
```

Commission 4, the programme. Printed from the function object itself; the plate opposite is its return value.

A page that reads right to left

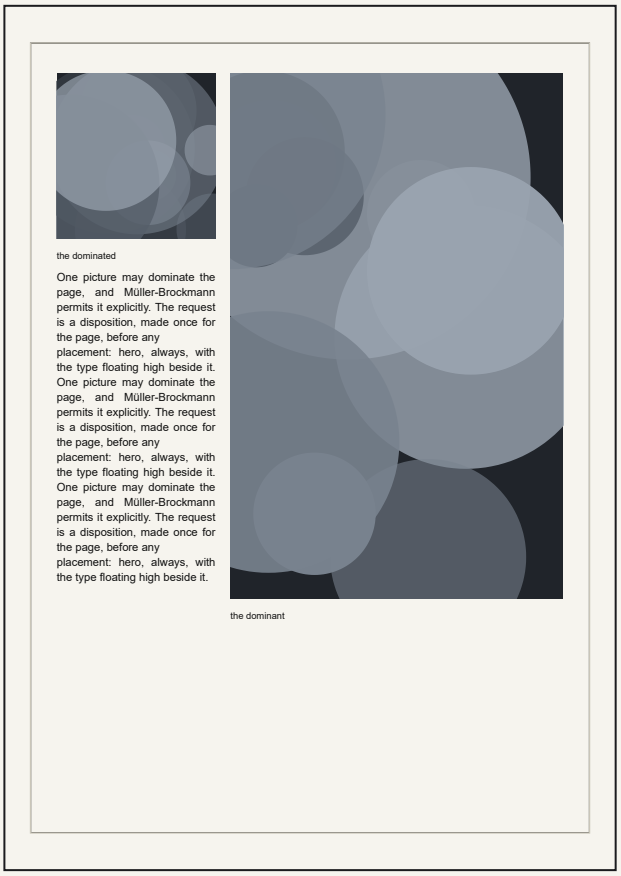
Direction as one option among the others (Commission 5). The same composer, the same limits, the mirror exact; the Arabic is measured shaped in the browser this manual is composing in.

```
// the same machinery, reading right to left
const g = G.grid({ page: { w: 298, h: 421 },
  margins: { inner: 18, head: 20, outer: 18, tail: 26 },
  columns: 2, columnGutter: 10, line: 12, rows: 4, rowGutterLines: 1 });
const story = [
  'العمود الأول هو الأيمن، والحافة المُتراشرة تقع على اليسار، ومسافة أول السطر تقع على اليمين.',
  'البذرة نفسها تعيد الصفحة نفسها إلى الأبد، وهذه الصفحة برنامج من أحد عشر سطرًا.',
];
return G.renderPage({ grid: g, background: '#f6f4ee',
  items: G.composeDocument({ grid: () => g, styles: { body: G.style(9, 3, { font: 'ar' }) },
    story, seed: 'rtl', folio: false, direction: 'rtl',
    bodyAlign: 'justify', paragraphDevice: 'indent' }).pages[0].items });
```

Commission 5, the programme. Printed from the function object itself; the plate opposite is its return value.

A dominant picture

The hero disposition, requested with certainty (Commission 6). Müller-Brockmann permits one picture to dominate the page, and the request is made once, page-level, before placement; the beam then serves it,



Commission 6, the result. heroChance set to certainty: one picture dominates (MB p.70), and the small one relates to it or pays for not.

and the small picture pays rent to the large one under the harmony weights.

Commission 5, the result. Direction as an option: the first column is the rightmost, the indent on the right, measured shaped.

21 THE CANON, PAGE BY PAGE

What follows is the canon the library executes, each rule with its citation. The list is printed in the manual for the same reason the interface is: a library that claims to compile a book owes its reader the page numbers.

No half lines in typography: every vertical distance is whole lines (MB pp.58-59). Field height is a whole number of text lines, and the gutters between fields are whole empty lines (MB pp.64, 134). The narrower the column, the smaller the typeface (MB p.57). Seven to ten words a line, 8 to 12 point for the text of books (MB pp.18, 30-31).

Cross-size register: every style's line height meets one module (MB pp.59, 66). A picture's width matches the width of a column of text (MB p.63). The band under a captioned picture grows in whole body lines (MB p.64). Captions belong in the caption column, beside their picture (MB pp.63, 87, 120). The margin column sits at the outer edge, and mirrors (MB p.55).

Few graded picture sizes, and one picture may dominate (MB pp.11, 70). The type area floats high: mass may not sink (MB p.51). Lines may be set flush right and left, but never the last (MB p.80). Statistics take the size of one to four grid fields, so a chart's bars are whole text lines (MB pp.14, 58-59).

A title is set in its own face, on whole slots of the register, in one of eight canonical placements (MB pp.46-47, 87). Empty spaces around titles are whole lines; the rest zone gives a title its importance (MB pp.69-70). A paragraph announces itself by an empty line, an indented first line, or an initial (MB pp.34, 36). The centred axis is one of the six settings of text (MB p.79). A cut-out is tied down by a tint beneath, a field border, bracketing rules, or an overprint (MB p.98).

The type area may stand in a 1:2 relation to the paper area, with wide spines for thick books (MB p.51). The mobile grid: one unit count, many simultaneous divisions (KG pp.58-61). The morphological box: the parameter space, enumerated (KG p.59). Instead of solutions for problems, programmes for solutions (KG, 1964, the sentence this library is a compilation of).

```
// one dominant picture: the hero disposition, requested
const g = G.grid({ page: { w: 298, h: 421 },
  margins: { inner: 14, head: 16, outer: 14, tail: 22 },
  columns: 3, columnGutter: 8, line: 8, rows: 4, rowGutterLines: 1 });
const body = G.style(6, 2, { font: 'sans' });
const text = 'One picture may dominate the page, and Müller-Brockmann permits ' +
  'it explicitly. The request is a disposition, made once for the page, ' +
  'before any placement: hero, always, with the type floating high beside it.';
return G.renderPage({ grid: g, background: '#f6f4ee',
  items: G.composeDocument({
    grid: () => g, styles: { body, caption: G.style(5, 3, { font: 'sans' }) },
    story: text + ' ' + text + ' ' + text, seed: 'hero',
    figures: [
      { id: 'big', seed: 'monument', sizes: [{ cols: 2, rows: 3 }], caption: 'the dominant' },
      { id: 'small', seed: 'pebble', sizes: [{ cols: 1, rows: 1 }], caption: 'the dominated' },
    ],
    dispositions: { bands: [0], bandPull: 2, heroChance: 1, heroPull: 2 },
    folio: false, bodyAlign: 'justify', paragraphDevice: 'indent',
  }).pages[0].items });
```

Commission 6, the programme. Printed from the function object itself; the plate opposite is its return value.

22 EVERY OPTION, ACCOUNTED FOR

composeDocument takes one options object. Every key is listed here with its default and its reason, because an option that appears only in the type declarations is an option the reader will meet for the first time in a failure.

grid
A geometry, or a function of the page number and side that returns one. Bound work alternates rectos and versos and the margins mirror at the spine, so a function is the honest form; a single geometry is accepted for unbound leaves.

styles
The roles of the type system: body is required, and any role a paragraph names must exist. Roles arrive pre-checked by typeSystem, so an illegal line height cannot reach the composer.

story
A string for one continuous flow, or an array of paragraphs with roles, rules, space before and after in whole lines, keep-with-next, page breaks, initials, and quotes. The array form is the book form.

figures
Anchored pictures: each names the substring of the story it belongs beside, its graded sizes in whole fields, and optionally its aspect, caption, frame devices, bleed, chart data, or full-page claim. Placement is the beam's; citizenship is the anchor's.

seed
The string from which every open decision is drawn. Same seed, same book, forever; the default is the word doc, and changing it is the first thing a reader should try.

folio
Start number and placement, or false. Folios sit on the register like everything else.

textSpan and textSnap
How many grid columns one text column occupies, and whether figures snap to whole text columns. The book's own page sets two text columns on a four-column grid (MB p.87), and a picture that leaves a sliver of prose beside itself is the reason snapping defaults on when spans exceed one.

harmony, anchorPull, dispositions, explore
The published taste: the relational weights of Chapter 8, the pull toward the anchor, the per-page band and dominance choices, and the softmax temperature of the search. All overridable, all disclosed, all demonstrated in Part Two.

bodyAlign and justify
Ragged left or justified, and the elastic limits for word spaces as multiples of the natural space, shrink 0.55 and stretch 4 by default. The last line is never justified and no option makes it so.

direction
ltr or rtl: the reading order for columns, indents, and ragged edges. Demonstrated above; measured shaped when the writing system requires it.

paragraphDevice and indentWidth
The empty line or the first-line indent (MB p.34), and the em of the indent when indenting, defaulting to the body size.

minSegmentLines
The shallowest strip of text the composer will fill, three lines by default, because two lines alone read as a fragment wherever they stand.

marginCaptions
Captions move to the margin column when the page has one, and back under their pictures when told to stay.

captionAir, titleRule, quoteFit
The breathing room around an under-caption before the band grows a line (MB p.64); the offset and weight of the hairline under a titled line (MB p.47, placement eight); the ceiling and leading of a pull quote fitted to its field.

runningHead
True for the current chapter's title, a fixed string, or a function of the page number, side, and chapter. Set at the outer edge of the head margin, in the runningHead role if the type system has one and the caption role otherwise,

on every page except chapter openings and the first. The head at the top of this page is this option at work.

notes, on the paragraph
A paragraph may carry notes. The library numbers them across the book, appends the superscript marker to the paragraph's text before anything is measured, and sets the notes at the foot of the last text column of the page where the paragraph ends, above a short hairline, in the note role, else the caption. A note that cannot stand whole at the foot of its column is refused with the arithmetic stated; notes are never split across pages. The previous chapter carries two.

the page token
Story text may carry the token page:figureId in curly braces, and it resolves to the page the figure lands on. Pages depend on the text and the text depends on the pages, so the library composes, substitutes, and recomposes until the numbers hold still. Unresolved ids are set as 00 and reported. The cross-references in the opening of Part Two are this token at work.

report.contents and contentsLeaf
The report lists every chapter and head with the page it landed on, and contentsLeaf turns that list into a contents page: titles left, folios flush at the column edge. The contents leaf of this volume is set with it.

title, titleRows, maxPages, ink
The optional opening title and its reserved rows; the runaway guard, fifty pages by default; and the ink, the default colour of everything not otherwise coloured.

23 CLOSING

The reader now possesses the specification, the demonstrations, the canon with its page numbers, the accounting of every option, the interface in full, and the names of the tests that hold it all in place. Nothing about this volume is exempt from itself: it was composed by the machinery it documents, from the seed printed in its colophon, and every claim in it can be re-run. The manual considers that the only binding kind of documentation, and is composed accordingly.

THE INTERFACE

The public interface follows, in full, as the TypeScript declarations ship it: 444 lines. The manual prints the interface because an interface a reader cannot see is an interface the reader must guess, and this volume was written against guessing.

```
// Type declarations for geviert : hand-written, kept honest by the test suite.
// The library itself is plain ES modules; these types are the map, not the
// territory. Where a rule cites a page, it cites Müller-Brockmann, Grid
// Systems in Graphic Design (1981) unless marked KG (Gerstner, Designing
// Programmes, 1964).

// ── type & measurement ──────────────────────────────────────────────

export interface Style {
size: number;
leading: number;
/** size + leading : the vertical unit everything registers on */
lineHeight: number;
font: string;
weight: 'normal' | 'bold' | 'semibold' | number;
italic?: boolean;
/** optional per-role ink (used when the style is a typeSystem role) */
color?: string;
/** optional per-role setting; 'center' is the centred axis (p.79) */
align?: 'left' | 'center' | 'justify';
}

/** A text style. Leading is the space ADDED to the size (9/3 → 12pt line). */
export function style(size: number, leading: number, opts?: {
font?: string; weight?: Style['weight']; italic?: boolean; color?: string;
}): Style;

/**
* Enforces the cross-size register (pp.59, 66): every role's line height must
* divide the module or be a whole multiple of it. Throws with the nearest
* legal settings named when a role breaks it.
*/
export function typeSystem<R extends Record<string, Style>>(spec: { module: number; role
s: R }): {
module: number; roles: R;
};

/** Width of a string in a style, from the registered metrics or the seam. */
export function measure(text: string, st: Style): number;
export function wordsPerLine(width: number, st: Style): number;

/**
* The largest face (min..max) whose measure holds `words` per line : the
* column decides the face (p.57); 8–12pt is the book floor (p.18).
*/
export function sizeForMeasure(width: number, opts?: {
words?: number; font?: string; min?: number; max?: number;
leadingRatio?: number; weight?: Style['weight'];
}): { size: number; leading: number; lineHeight: number; wordsPerLine: number; meets: bo
olean };

export interface BreakOptions {
/** Knuth–Plass when true (default); greedy when false */
optimal?: boolean;
```

```
mode?: 'left' | 'justify';
}
/** Break a paragraph at a fixed measure. */
export function breakLines(text: string, width: number, st: Style, opts?: BreakOptions):
string[];
/** The same breaker where the measure may change per line (drop caps, intrusions). */
export function breakVariable(text: string, widthFor: (line: number) => number, st: Styl
e, opts?: BreakOptions): string[];
export function breakIndented(text: string, width: number, st: Style, indentLines: numbe
r, indentWidth: number, opts?: BreakOptions): string[];

export interface FontMetrics {
family: string; capHeight: number; xHeight: number; descent: number;
fallbackWidth: number; widths: Record<string, number>;
dataUri?: string; format?: string;
}
export function registerFont(name: string, metrics: FontMetrics): void;
export function fontMetrics(name: string): FontMetrics;
/** @font-face CSS for every registered font that carries a dataUri. */
export function fontFaceCSS(): string;

/** Replace the measurement backend (the browser adapter uses this). */
export function setMeasurer(fn: ((text: string, st: Style) => number) | null): void;
/**
* Optional fast path for GREEDY breaking (never Knuth–Plass). Must agree with
* the built-in breaker line for line; return null to decline.
*/
export function setGreedyBreaker(fn: ((text: string, width: number, st: Style) => string
[] | null) | null): void;

/** A dropped initial (p.36): size derived from N body lines of cap height. */
export function dropCap(letter: string, opts: {
bodyStyle: Style; lines?: number; font?: string; weight?: Style['weight'];
italic?: boolean; color?: string; snap?: boolean;
}): { letter: string; lines: number; width: number; style: Style; color?: string; offset
Y?: number };

// ── paper, margins, grid ─────────────────────────────────────────────

export interface Rect { x: number; y: number; w: number; h: number }
export interface Margins { inner: number; head: number; outer: number; tail: number }

export function marginsFromRatio(ratio: 'classical' | 'golden' | Margins, scale: number)
: Margins;
/**
* Scale a margin canon so the type area is exactly `fraction` of the page
* area (p.51 diagrams 1–2: the 1:2 relation).
*/
export function marginsForAreaFraction(page: { w: number; h: number }, ratio: 'classical
' | 'golden' | Margins, fraction?: number): Margins;
export function typeArea(page: { w: number; h: number }, margins: Margins, side?: 'left'
| 'right'): Rect;

export interface GridGeometry {
```

```
page: { w: number; h: number };
margins: Margins;
typeArea: Rect;
columns: Rect[];
rows: Rect[];
fields: Rect[];
line: number;
columnGutter: number;
rowGutter: number;
linesPerField: number;
side: 'left' | 'right';
/** rect spanning fields [col..col+cols) × [row..row+rows) */
field(col: number, row: number, cols?: number, rows?: number): Rect;
baselines(): number[];
}

/**
* The modular grid (pp.57–70): field heights are whole lines, gutters are
* whole empty lines. There is no way to express an off-grid position.
*/
export function grid(spec: {
page: { w: number; h: number } | 'A4' | 'A5' | 'A3';
margins: Margins;
columns: number; columnGutter: number;
line: number; rows: number; rowGutterLines?: number;
side?: 'left' | 'right';
}): GridGeometry;

/** The book's own dimensioned A4 reference grids (pp.73, 77, 88). */
export const presets: {
mb8(side?: 'left' | 'right'): GridGeometry;
mb20(side?: 'left' | 'right'): GridGeometry;
mb32(side?: 'left' | 'right'): GridGeometry;
};

// ── flow ─────────────────────────────────────────────────────────────

export interface Paragraph {
text: string;
/** a heading keeps `keep` lines of what follows with it */
keepWithNext?: boolean;
/** whole empty lines before (number), or false; default 1 ('line' device) */
spaceBefore?: number | boolean;
/** extra whole empty lines after : the rest zone (p.69) */
spaceAfter?: number;
/** set in styles[role]: its own face, whole slots, never split (pp.46-47, 87) */
role?: string;
/** hairline under the titled line (placement example 8, p.47) */
rule?: boolean;
/** a dropped initial, from dropCap() */
initial?: ReturnType<typeof dropCap>;
/** open a new page before this paragraph (a chapter, a concert) */
pageBreak?: boolean;
/**
```

```
* Footnotes. Numbered across the book; a superscript marker is appended to
* this paragraph's text before measurement, and the notes are set at the
* foot of the last text column of the page where the paragraph ENDS, above
* a short hairline, in styles.note (else the caption role). Array-form
* stories only.
*/
notes?: string[];
/** shorthand for notes: [note] */
note?: string;
}

export interface FlowBox {
rect: Rect; lines: string[]; indents: number[]; flush: boolean[];
roles: (string | undefined)[]; slots: number[]; ruleAfter: boolean[];
}
export function flowText(text: string, rects: Rect[], st: Style): {
boxes: { rect: Rect; lines: string[] }[]; overflow: string | null; overflowWords: numb
er; spareLines: number;
};
export function flowParagraphs(paragraphs: (Paragraph | string)[], rects: Rect[], st: St
yle, opts?: {
keep?: number; widowControl?: boolean; minLines?: number;
mode?: 'left' | 'justify'; optimal?: boolean;
styles?: Record<string, Style> | null;
/** paragraph device (p.34): 'line' (default) or 'indent' */
device?: 'line' | 'indent';
indentWidth?: number | null;
}): {
boxes: FlowBox[];
initials: { box: number; line: number; slot: number; letter: string; initial: ReturnTy
pe<typeof dropCap> }[];
overflow: string | null; overflowWords: number;
overflowParagraphs: Paragraph[]; spareLines: number;
};

// ── the document layer ──────────────────────────────────────────────

export interface Figure {
id?: string;
/** substring of the story this figure belongs beside ("(Plate 3)") */
anchor?: string;
/** size vocabulary in grid columns × field rows : few graded sizes (p.11) */
sizes?: { cols: number; rows: number }[];
cols?: number; rows?: number;
href?: string;
/**
* preferred w/h. The beam scores placements against it, and a placed picture
* is NEVER cropped: when the chosen fields miss the aspect, the picture keeps
* its proportions inside them (full width hung from the top, or full height
* on the reading edge) and the caption follows the picture's edge.
*/
aspect?: number;
aspectWeight?: number;
caption?: string;
```

```
captionColor?: string;
/** one ink (feColorMatrix ramp in SVG) */
duotone?: boolean | { shadow: string; highlight: string };
/** 'cover' opts back in to cropping, for photographs that can afford it */
fit?: 'meet' | 'cover';
/** run off the paper on these sides */
bleed?: boolean | ('left' | 'right' | 'top' | 'bottom')[];
/** take the whole leaf, caption in the margin */
fullPage?: boolean;
captionBg?: string;
/** ── the cut-out apparatus (p.98) ── */
/** colour area beneath the cut-out, sized to its fields */
tint?: string;
/** line border with the field's dimensions */
border?: boolean; borderWidth?: number; borderColor?: string;
/** rules at the field's top and bottom limits */
bracket?: boolean; bracketWidth?: number; bracketColor?: string;
/** colour printed over the photograph : dominant */
overprint?: string;
/** a pull quote occupying fields, sized to fill them */
quote?: string; quoteStyle?: Style; quoteColor?: string;
/** a statistic occupying fields; bars are whole text lines (pp.14, 58-59) */
chart?: {
data: { label?: string; value: number }[];
max?: number; barColor?: string; color?: string;
format?: (v: number) => string;
};
seed?: string;
}

export interface PageItem {
kind: 'text' | 'image' | 'block' | 'rule' | 'frame' | 'chart';
rect: Rect;
[key: string]: unknown;
}
export interface ComposedPage {
number: number; grid: GridGeometry; items: PageItem[];
side: 'left' | 'right'; plate?: boolean;
}

/**
* The point of the library: story + figures + grid + seed → pages.
* Deterministic: the same seed returns the same book, forever.
*/
export function composeDocument(spec: {
grid: GridGeometry | ((ctx: { pageNo: number; side: 'left' | 'right' }) => GridGeometr
y);
styles: Record<string, Style> & { body: Style };
/**
* The manuscript. Text may contain "{page:figureId}" tokens: each resolves
* to the page its figure lands on (compose, substitute, recompose until
* stable); unknown ids are set as 00 and listed in report.unresolvedRefs.
*/
story: string | (Paragraph | string)[];
```

```
title?: string | null; titleRows?: number;
figures?: Figure[];
seed?: string;
folio?: { start?: number; placement?: 'second-column' | 'left' | 'outer' | 'center' }
| false;
maxPages?: number;
ink?: string | null;
/** grid columns per text column (the book's own page spans 2, p.87) */
textSpan?: number;
textSnap?: boolean | null;
/** the taste dial, in cost units : see each key's page in the source */
harmony?: { newSize?: number; sameBand?: number; sharedEdge?: number; stacked?: number
; adrift?: number };
/** pull toward the anchor's column: a preference, not a law */
anchorPull?: number;
dispositions?: { bands?: number[]; bandPull?: number; heroChance?: number; heroPull?:
number };
bodyAlign?: 'left' | 'justify' | 'center';
minSegmentLines?: number;
marginCaptions?: boolean;
/** paragraph device (p.34): 'line' | 'indent' */
paragraphDevice?: 'line' | 'indent';
indentWidth?: number | null;
/** elastic limits for justified spaces, in multiples of the natural space */
justify?: { shrink?: number; stretch?: number };
captionAir?: number;
titleRule?: { offset?: number; width?: number };
quoteFit?: { ceiling?: number; leading?: number };
/** softmax temperature of the page search; 0 = deterministic top-k */
explore?: number;
/**
* A running head on every page except chapter openings and the first:
* true (the current chapter's title), a fixed string, or a function of
* ({ pageNo, side, chapter }). Set at the outer edge of the head margin,
* in styles.runningHead, else the caption role.
*/
runningHead?: boolean | string | ((ctx: { pageNo: number; side: 'left' | 'right'; chap
ter: string | null }) => string);
}): {
pages: ComposedPage[];
report: {
fits: boolean; leftoverWords: number;
figures: { id: string; placed: boolean; page?: number; anchorPage?: number; drift?:
number }[];
/** every chapter and head, with the page it landed on : feed to contentsLeaf() */
contents: { title: string; role: string; page: number }[];
/** "{page:id}" tokens whose figure never placed (set as 00 in the text) */
unresolvedRefs?: string[];
};
};

// ── programmes (named presets) ──────────────────────────────────────

/**
```

```
* Complete, opinionated commissions ready to spread into composeDocument:
* a legal grid, a registered type system, and the setting options a book of
* that kind wants. One line to a good page; every key overridable after the
* spread. book: MB's own A4 page (p.87). essay: one generous measure with a
* deep margin. booklet: A5, two narrow columns, small face.
*/
export const programmes: {
book(opts?: { font?: string; accent?: string; page?: { w: number; h: number }; module?
: number }): ProgrammePreset;
essay(opts?: { font?: string; page?: { w: number; h: number }; module?: number }): Pro
grammePreset;
booklet(opts?: { font?: string; accent?: string; page?: { w: number; h: number }; modu
le?: number }): ProgrammePreset;
};
export interface ProgrammePreset {
grid: (ctx: { side: 'left' | 'right' }) => GridGeometry;
styles: Record<string, Style>;
textSpan: number;
bodyAlign: 'left' | 'justify';
paragraphDevice: 'line' | 'indent';
}

// ── rendering ──────────────────────────────────────────────────────────

/** One page → a self-contained SVG string. */
export function renderPage(spec: {
grid?: GridGeometry; page?: { w: number; h: number };
items?: PageItem[];
showGrid?: boolean; showBaselines?: boolean;
background?: string; scale?: number;
}): string;

/**
* One page → live DOM: selectable text on the baseline grid, baselines
* MEASURED from the browser (never computed from font metrics).
*/
export function renderDOM(page: { grid?: GridGeometry; page?: { w: number; h: number };
items: PageItem[] },
container: HTMLElement,
opts?: { scale?: number; background?: string; showGrid?: boolean; showBaselines?: bool
ean }): HTMLElement;
export function clearBaselineCache(): void;

/** Measure through the canvas of the very fonts about to be drawn. */
export function useBrowserFonts(opts?: { families?: Record<string, string>; scale?: numb
er }): Promise<void>;
export function pageFromElement(el: HTMLElement): { w: number; h: number };

// ── helpers ────────────────────────────────────────────────────────────

/**
* A contents leaf from report.contents: titles on the left of a column, page
* numbers flush at its right edge, heads indented one em. Fills columns as the
* list demands. Returns items for a hand-built leaf.
```

```
*/
export function contentsLeaf(g: GridGeometry, entries: { title: string; role: string; pa
ge: number }[], opts: {
styles: Record<string, Style> & { body: Style };
title?: string; roles?: string[]; ink?: string; accent?: string;
/** list rhythm, in body lines per entry */
leading?: number;
/** grid columns per list column (default: half the grid) */
span?: number | null;
}): PageItem[];

export function folio(g: GridGeometry, pageNumber: number, opts?: {
placement?: 'second-column' | 'left' | 'outer' | 'center';
lines?: number; style: Style; side?: 'left' | 'right';
}): PageItem;
export function captionBelow(imageRect: Rect, text: string, st: Style, opts?: { lines?:
number; gapLines?: number }): PageItem;

// ── hyphenation ──────────────────────────────────────────────────────

export function setHyphenator(fn: ((word: string) => string[]) | null): void;
export function hyphenatorFrom(hyphenateSync: (word: string) => string): (word: string)
=> string[];

// ── randomness ───────────────────────────────────────────────────────

/** xmur3 + sfc32: the seeded PRNG everything deterministic runs on. */
export class Rand {
constructor(seed: string);
dec(): number;
int(maxExclusive: number): number;
choice<T>(arr: T[]): T;
}
export function xmur3(seed: string): () => number;
export function sfc32(a: number, b: number, c: number, d: number): () => number;

// ── the programme layer (Gerstner) ───────────────────────────────────
// Typed loosely on purpose: the solver's DSL is documented in the README and
// research/foundations.md; these types keep call sites honest without
// freezing a young API.

export function programme(spec: object): {
solutions(opts?: { limit?: number }): object[];
count(): number;
layout(seed: string): object;
reroll(seed: string, opts?: { lock?: string[] }): object;
sample(seed: string, n: number): object[];
};
export function mobileGrid(units: number, opts?: object): object;
export function mobileProgramme(spec: object): object;
export function gerstnerNumber(divisions: number[], gutter: number): { units: number; wi
dths: Record<number, number[]> };
export function compoundProgramme(spec: object): object;
export function morphologicalBox(axes: Record<string, unknown[]>): {
```

```
count: number; at(index: number): Record<string, unknown>; sample(seed: string): Recor
d<string, unknown>;
};

export function mfield(...args: unknown[]): object;
export function malign(...args: unknown[]): { left(): object; right(): object; top(): ob
ject };
export function mbelow(...args: unknown[]): object;
export function mwhitespace(...args: unknown[]): object;
export function story(...args: unknown[]): object;
export function initialIndents(...args: unknown[]): number[];
```

THE SUITE, BY NAME

The library carries 112 tests, and their names are assertions of the canon. They are printed here in full because a claim of coverage without a list of claims is weather. Each runs on every change, with no network and no browser.

1. imageSize reads PNG dimensions from a data URI
2. aspect preference picks the field span nearest the source ratio
3. aspect is a preference, not a guarantee: anchor proximity can still win
4. single fixed size still works (cols/rows form)
5. balance: a large figure is not left adrift in the middle band
6. Gerstner's typogram box: 13 parameters, thousands of chains (KG p.59)
7. box: deterministic pick, valid chains, mixed-radix enumeration
8. tint rule: inset indents the text, bleed extends the tint (MB pp.101-103)
9. units: the book constants (MB p.18)
10. paper: ISO 216 table exact (MB p.16)
11. line divisions: the 57→55 worked example (MB pp.58-59)
12. line divisions: 53 = 9×5+8 = 6×8+5 (MB p.67)
13. line divisions: MB's five ways for 59 lines (MB p.67)
14. cross-size baseline module: 24pt (MB pp.59, 66, 87)
15. gerstner number: 58 is minimal for divisions 1..6 at gutter 2 (KG p.61)
16. gerstner arithmetic: the exact decompositions (KG p.61)
17. margin canons (MB pp.41, 51)
18. type area = half the paper area (MB p.51 diagrams 1-2)
19. margin advisories catch the book's bad examples (MB pp.40-41)
20. the 8-field reference grid (MB p.73)
21. the 20-field reference grid (MB p.77)
22. the 32-field reference grid shares the 8-field envelope (MB p.88)
23. canon-mode grid fits fields to whole lines (MB p.58)
24. merged fields include interior gutters (MB p.60)
25. picture-format vocabulary: columns × rows sizes (MB pp.75, 79, 90-92)
26. mobile grid: Capital spec (KG p.61)
27. mobile grid rejects a non-dividing unit count with a helpful error
28. composeDocument: everything fits, every figure placed exactly once
29. composeDocument: figures never overlap text or each other
30. composeDocument: deterministic per seed, varies across seeds
31. composeDocument: figure drift is reported, not hidden
32. composeDocument pages render
33. the anchor column is a preference: seeds move pictures across columns
34. the spare column is a margin column, and it mirrors
35. captions set in the margin column when there is one, and mirror with it
36. pageBreak: each section opens a fresh page
37. direction rtl: columns fill right to left and items carry dir
38. flowText fills boxes to whole-line capacity and threads the remainder
39. flowText reports overflow honestly, never clips silently
40. boxes of different widths re-break the same story
41. story emits renderable items and the red overflow marker
42. flowParagraphs marks the line that ends each paragraph
43. renderPage does not justify a paragraph-final line inside a block
44. a titled paragraph occupies whole slots in its own style
45. a title whose line height breaks the register is refused, with the citation
46. a title is never split across boxes: it moves whole
47. registerFontFile: a TTF becomes a measurable geviert font in one call
48. registerFontFile refuses helpfully without its optional peer
49. programmes: each preset composes a legal book in one spread
50. programmes: overrides spread over the preset
51. running heads: outer edge, skipped on openings and page one
52. contentsLeaf: titles left, folios at the column edge
53. footnotes: marker in the text, note at the foot, no overlap
54. footnotes: notes land on the page where their paragraph ends
56. crossRefs: unknown ids are reported, set as 00
57. table measurement refuses joining scripts, teaching the fix
58. captionFit: one 7/1 caption line lives in the 15pt gutter (MB p.63)
59. gutterCaption centres in the gutter and refuses impossible spots
60. figure: consumed extent snaps to whole body lines with clearance (MB pp.110, 134)
61. with no hyphenator the breaker behaves exactly as before
62. breakPoints honours minimum stubs and word length
63. hyphenation tightens the greedy breaker and never loses a letter
64. optimal (Knuth–Plass) hyphenates when justifying, and sparingly when ragged
65. punctuation does not prevent hyphenation (real prose wears commas)
66. the ladder rule caps consecutive hyphenated lines
67. syllablesFrom adapts a soft-hyphen string API
68. the real hyphen package drives it, if installed
69. Knuth–Plass beats greedy on total badness (the objective it optimises)
70. the ladder rule is a HARD constraint in the optimal breaker too
71. paragraphs are separated by one whole empty line (MB p.80)
72. a heading never strands at the foot of a segment
73. a heading with room keeps its body in the same segment
74. orphans and widows are refused
75. overflow paragraphs are returned for the next page
76. solver enumerates the complete solution space on a countable case
77. unary constraints prune candidates
78. binary constraints hold in every solution
79. global constraints filter complete layouts
80. distinctSizes enforces MB p.11 calm rule
81. layout(seed) is deterministic and seed-sensitive
82. reroll keeps locked items fixed
83. rects land on the grid geometry
84. Rand: deterministic stream
85. renderSVG smoke: grid, layout, mobile
86. sampling reaches the whole space, not one corner of it
87. small spaces are still enumerated exhaustively (no sampling loss)
88. typeSystem enforces the 24pt register (MB pp.59, 66, 87)
89. measure and breakLines behave sanely
90. wordsPerLine advisory lands near MB's 7-10 for the book's own measure
91. renderPage typesets: text lands on baselines, images clip, folio/caption helpers
92. mobile programme: cross-division placement, determinism, locks
93. malign aligns across divisions
94. sizeForMeasure derives the face from the column, monotonically, within 8-12pt
95. folio box is the numeral, not a slot
96. setGreedyBreaker: fast path serves greedy only, and null falls through
97. justified lines fill the measure exactly; the last line does not
98. justify never produces grotesque word spaces (falls back to ragged)
99. breakIndented shortens exactly the first n lines
100. an initial letter is drawn once and removed from the flowed text
101. a pull quote occupies fields and text flows around it
102. a full-page plate takes its own leaf, edge to edge
103. rotated text emits a rotation transform
104. square pages are just a page size
105. dropCap derives its size and well instead of guessing

111. a chart figure occupies fields and its bars snap to whole lines

112. a role may set on the centred axis

THE GEVIERT MANUAL. Set by the library it specifies: grotesque 9 on 12 on an eight-column lattice of sixty-four fields in the proportion of the paper (the column pitch is the row pitch divided by the square root of two, so every square span of fields is a leaf of the A-series, exactly, gutters included). Four-column text, first lines indented one em, justified with elastic spaces between 0.55 and 4 of the natural space, plates placed by the beam under the published weights, composed from seed “manual-1” in 1638 milliseconds. The cover reproduces the construction of the cover of Grid Systems in Graphic Design (Niggli, 1981), to which this volume owes its rules and its manners. The demonstrations of Part Two were composed together with this copy, by the machinery they demonstrate. The interface and the test names are printed from the working tree. GEVIERT, das Geviert, the em quad.