The Topological Rupture

Cognition, Coordination, Transformation

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Part I.

Topology of Social Order

1. History as a Sequence of States

1.1. Problem

History is traditionally told along a timeline. Events are arranged chronologically, actions described sequentially. The Second World War began in 1939 and ended in 1945. In between followed battles, political decisions, economic transformations, and individual fates.

This mode of presentation is intuitive, but it produces systematic distortions. It forces parallel developments into a linear order. In doing so, it suggests causalities that arise from the sequence of presentation, not from the structure of the world itself. What is narrated in succession appears causally connected, even if it merely occurred simultaneously.

Social reality, however, is fundamentally parallel. At any given moment, countless processes take place simultaneously: military, economic, institutional, cultural, and individual. Classical event narration can only resolve this parallelism by selecting. This selection is necessary, but it obscures the simultaneity of processes and favors monocausal explanations.

The result is a historiography that is strongly narrative but structurally imprecise. It explains sequences of events but describes states only implicitly. It speaks of change without making clear what something is moving away from and toward.

If history is to be more than a succession of plausible narratives, a fundamental question therefore arises: Is it possible to describe societal development without primarily narrating it as a chain of events and actions?

1.2. Historiography as a Model

Every form of historiography is a model. It reduces complexity, selects, abstracts, and leaves the greater part of simultaneous details unconsidered. This reduction is not a deficiency but a precondition of knowledge.

As a model, historiography carries implicit assumptions about relevance, causality, and coherence—assumptions that operate even when they are not made explicit. The problem is not that historiography is model-like, but that its model character usually remains implicit. Categories are seldom questioned, the mode of presentation taken for granted.

If history is inevitably modeled, the question is not whether we use a model, but which one—whether it is suited to the subject matter.

1.3. Intuitive Solution

Rather than describing history primarily as a sequence of events, we propose a shift in perspective. We consider not first the temporal

succession of actions, but the state of the world at a given point in time.

Such a state is a snapshot. It describes how the world is structured at a particular moment: which conflicts exist, which institutions are effective, which forms of cooperation and violence dominate. The temporal distance between two such snapshots can be chosen arbitrarily.

One can imagine this perspective as a vertical cross-section through the course of time. While classical historiography proceeds along the time axis, this approach fixes a point in time and describes the world in its simultaneity. Historical development then occurs not within a state itself, but between states.

This approach is familiar from other domains. In temporal databases, one speaks of snapshots: complete state descriptions at a specific point in time. Similar to comics, movement arises not within a single frame but between frames. The action lies in the interpolation, not in the individual panel.

If one transfers this logic to history, development becomes comprehensible as a sequence of states. These states can be chosen coarsely or finely. Their temporal density determines the granularity of observation, not its fundamental validity.

The difference between both perspectives can be illustrated with a well-known example. In the classical, horizontal presentation, the Second World War is described as a time period: from 1939 to 1945. Events within this period are connected into a coherent narrative.

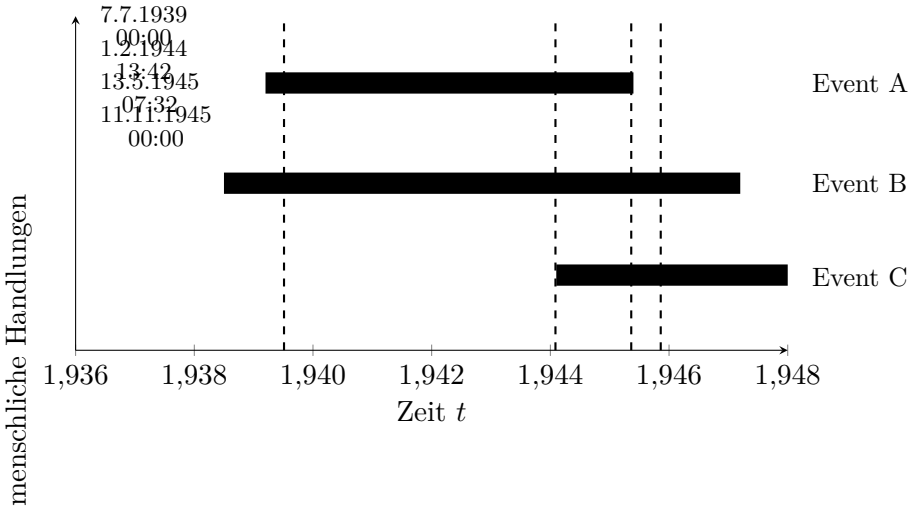

Figure 1.1.: Horizontal event narration as temporal intervals (bands) and vertical cross-sections through the course of time as snapshots of societal states.

The vertical perspective proceeds differently. It fixes individual, arbitrarily chosen points in time and describes the state of the world at each such moment, regardless of whether a historically marked event takes place on that day. For example:

In this view, the war appears not as an ongoing event but as a sequence of different world states. Historical development then lies in the changes between these states, not in the description of individual events.

1.4. Formal Definition

Formally, we consider history as a sequence of states. Each state describes the world at a specific point in time completely within the framework of the chosen model. Time functions merely as an index, not as a structuring principle.

Let X be the set of all possible societal states. A single state $x \in X$ describes a snapshot of the societal order. History then appears as a sequence of such states

$$x_1, x_2, x_3, \ldots$$

where the indices merely express a temporal order but contain no assertion about causality or dynamics.

The actual historical development lies not in the states themselves but in the transitions between them. These transitions are deliberately left unspecified at this point. The model remains agnostic with respect to causes, velocities, and mechanisms of change.

1.5. What Can Be Thought with This

This perspective fundamentally changes how history can be discussed. Instead of explaining individual events, the description of stable and unstable states moves to the foreground. Questions about causes recede in favor of questions about structure.

The approach makes it possible to speak about historical development without knowing the driving forces in detail. It suffices to describe that the world has moved from one state to another. The explanation of this movement can remain open or be supplemented later.

At the same time, it becomes evident that many seemingly opposing historical narratives are merely different projections of the same state. Political, economic, or cultural perspectives do not describe different worlds but different aspects of the same moment.

Finally, this approach permits a more precise separation between description and evaluation. States can be analyzed without normatively classifying them. Change becomes visible without having to interpret it as progress or decline.

The price of this abstraction is the renunciation of narrative vividness. The gain is structural clarity.

The description of history as a sequence of states replaces event narration without already determining its internal structure. The shift in perspective clarifies how historical development can be viewed, but not yet what the observed snapshots consist of.

To continue working with this approach, it must therefore be precisely determined what constitutes a societal state.

Concluding Question. If history is to be describable as a sequence of states, the question arises of what such a state consists of. This question is more demanding than it initially appears.

A description that is adequate only for historically realized states is not sufficient. The model should capture past and present states, but equally future and counterfactual ones. It should not pursue historiography – the explanation of the past –, but philosophy of history: the construction of abstract structures that operate seamlessly across past, present, and possible futures.

What components must a societal state contain in order for such a universal description to become possible?

2. The Elements of a Societal State

2.1. The Snapshot

We describe the world at a given point in time as a state. Such a state is not an event and not an action, but a complete *snapshot* of society at that point in time. This snapshot encompasses the totality of all human institutions, practices, artifacts, and forms of coordinated action that are operative at that moment. We denote this totality by H.

Formally speaking, H does not describe individual actions but the structured totality of what people can do, are permitted to do, must do, or expect at that point in time. History is thus described not through the narration of events but through the comparison of such states.

2.2. The Environmental Conditions E

Humanity does not act in a vacuum but always conditioned by its (external) environment. The societal state at a point in time x is thus initially given by

$$x = (E, H),$$

where E denotes the environmental conditions under which this state exists.

With E we summarize all external conditions that enable, constrain, or structure human action without themselves being institutional constructions. These include, among others:

- demographic conditions,
- climatic and geographic conditions,
- available forms of energy,
- health-related framework conditions,

E is not a static background but changes over time. Climate change, epidemics, and population growth alter E partly slowly, partly abruptly. These changes do not act directly on specific institutions but initially on the possibility space of societal organization. Importantly: E does not determine societal states. It opens and closes possibilities. Which of these possibilities are realized is a question of societal structure.

2.3. The Reduction of H

The set H in its full extent is unmanageable. At any given point in time, countless individual actions, micro-practices, and situational decisions exist. Every form of historiography—regardless of method or epoch—reduces this diversity.

This reduction is necessary. Without it, no description would be possible. Historical models always filter out a large portion of the high-frequency details. Individual gestures, everyday routines, or singular events are lost in favor of more stable structures.

Our model makes this reduction explicit. We do not consider the complete set H but separate it along a functional frequency axis.

2.4. Low and Medium Frequencies

We distinguish two levels within H that are relevant for our purposes:

- very low frequencies,
- medium frequencies.

The very low frequencies change extremely slowly. They are so stable that they are usually not perceived as designed structures. They appear given, self-evident, almost natural. Precisely for this reason, they frequently elude analysis.

We denote this level by S. The medium frequencies constitute the concrete institutional manifestations of these primitives; they are introduced in the following section as R.

2.5. The Primitives S

S denotes the fundamental communicative and coordinative primitives of a society. They are the building blocks from which all further institutional forms are composed.

These primitives include, for example:

- state bureaucracy with forms, official channels, and stamps,

- "honor" as an archaic reputation management system,
- property as an abstract assignment of rights of disposal,
- money as a universal medium of communication and accounting,
- timekeeping by clocks as a synchronization mechanism.

These primitives are not necessarily centralized or hierarchical. They enable coordination without presupposing a particular power structure. The term "control" would be misleading here, as it already implies a power differential that is not present in all forms of society.

2.6. The Manifestations R

The primitives S do not produce a society. A society makes use of them and shapes from them concrete institutions, practices, norms, and cultural patterns.

We denote this level of concrete manifestation by R. It encompasses:

- institutional arrangements,
- organizational forms,
- cultural practices,
- legal and social norms,
- established routines of communal life.

Formally, we can write:

$$H = S + R,$$

where the high-frequency details are implicitly omitted.

This yields the following expression for the societal state:

$$x = (E, S, R).$$

2.7. Why Coordination Mechanisms Must Be Modeled Explicitly

In traditional historiography, the fundamental coordination and steering mechanisms of a society usually remain implicit. They appear as a self-evident background, not as designed structures. Precisely because they barely change over long periods of time, they are rarely discussed.

What remains constant becomes invisible. Bureaucracy, property, money, or timekeeping are not perceived as historically contingent mechanisms but as natural properties of societal order. Their existence is presupposed, not explained.

This implicit treatment is unproblematic in stable phases. As long as the underlying primitives do not change, it suffices to discuss their concrete manifestations. Therein lies, however, the structural danger: as soon as these deep mechanisms change, the concepts needed to describe this transformation are lacking.

Historical upheavals then appear sudden, chaotic, or irrational. In reality, it is not the change itself that surprises but the fact that its preconditions had not been made visible beforehand.

The explicit modeling of S therefore serves not completeness but visibility. It renders analyzable those structures that are otherwise presupposed as immutable and that, precisely for this reason, possess the greatest historical leverage.

2.8. What S Is — and What It Is Not

The coordination mechanisms S are not institutions, not actors, and not ideologies. Nor are they to be equated with culture or morality. Rather, S denotes the elementary communicative and coordinative primitives upon which societal action draws.

These primitives define not *what* is done but *how* societal coordination is fundamentally possible. They determine which forms of alignment, allocation, synchronization, or binding commitment are realizable at all.

S is thereby neutral with respect to concrete power relations. The existence of a coordination mechanism implies neither centralization nor hierarchy. Money, property, or timekeeping can occur in very different societal contexts and be embedded in very different ways.

Explicitly not part of S are:

- concrete organizations or institutions,

- concrete moral norm contents and norm systems,
- cultural narratives or value systems,
- individual or collective actors.

A note of clarification: The abstract mechanism of moral self-commitment—understood as a system of generalized behavioral rules that operates independently of social observation—is an element of S. The concrete contents of these norms, their religious embedding, and cultural manifestation belong, by contrast, to R. This distinction between abstract mechanism and concrete manifestation applies to all elements of S.

Equally, S is not to be equated with technology in general. Basic technologies such as fire, the wheel, or energy sources can likewise be conceived as primitives but would unnecessarily broaden the focus of this model. They can be incorporated without difficulty but are not decisive for the core pursued here.

S is thus not a complete explanatory model of societal order but a targeted abstraction. It isolates those deep structures that enable societal coordination without already determining their concrete realization.

2.9. The Formal Role of S

Formally, we regard S as a set of primitives without internal order—without hierarchy, weighting, or functional dependency between individual elements. This underdetermination is part of the model.

S is not deterministic: The existence of a coordination mechanism does not enforce a specific order but opens options that may be realized or ignored in R. Which combinations are stable is not a question of definition but of dynamics.

S functions as a structural deep layer. Changes in S are rare but consequential: they alter not individual institutions but the conditions under which institutions can meaningfully be formed.

2.10. The Space X

We denote by X the set of all possible societal states:

$$X = \{x = (E, S, R)\}.$$

This set encompasses *all* combinations, no matter how unrealistic:

- historically realized states,
- counterfactual states,
- future states that are unimaginable today,
- unstable or inconsistent combinations.

States that would never be stable under real conditions—for instance because E does not permit certain primitives or S does not admit a consistent manifestation in R—nevertheless belong to X. They exist as theoretical possibilities, even if they were never historically realized or would collapse immediately.

This model therefore also permits counterfactual history. Questions such as "What if telephones had already existed in the Middle Ages?" can be formally described within X, regardless of whether they would be plausible or stable.

2.11. Ontological and Epistemic X

The space X is ontologically extremely large. It encompasses all conceivable and inconceivable combinations of E, S, and R.

Our capacity for imagination, however, is limited. We can only conceive of those primitives that we know historically or are just beginning to glimpse, for instance through smart contracts or post-quantum computing. Beyond that—for example with far-reaching technological developments such as brain-to-chip interfaces—our intuition fails.

We therefore distinguish:

- an ontological X: the space of all possible states,
- an epistemic X: the small portion that we can conceive of at all.

For the further course of this book, this distinction is only of limited importance. Conceptually, we always operate with the ontological X. That our thinking can only partially follow this space is a human limitation, not a deficiency of the model.

2.12. States of Subsets of Society

The concept of a societal state is not restricted to humanity as a whole. A state $x \in X$ can equally be applied to arbitrary subsets of society.

For instance, we can consider a state pertaining to Africa in 1975 and compare it with a state in Brazil in 1983. At first glance, it may seem as though the state is being geographically restricted. In fact, what is being focused is not a space but a subset of actors and institutions. The state describes not a territory but the societal constellation under consideration: its environmental conditions, its coordination mechanisms, and its concrete manifestations.

Geographic terms serve merely as heuristic markers. They do not designate homogeneous units but refer to overlapping, partially independent societal structures. Within the same territory, multiple different states can exist simultaneously, overlapping only partially.

The model therefore explicitly permits:

- the comparison of different societal subspaces at different points in time,
- the analysis of parallel states within the same geographic space,
- the consideration of non-territorial societies or networks.

This makes clear: X is not a space of geographic locations but a space of societal constellations. Its elements are not countries or

regions but structured states of human coordination. The choice of the subset under consideration is an analytical decision, not an ontological determination.

All concepts introduced so far and all constructions that follow—in particular the topological structure of the space X introduced below—transfer seamlessly to such focuses on societal subsets. Open sets, convergence, boundaries, or continuity can be defined regardless of whether a state concerns humanity as a whole or an arbitrary subset. This focusing is powerful, yet in the language of mathematics *WLOG trivial*.

For reasons of readability and conceptual focus, we refrain from explicitly writing out this extension in each instance. Unless otherwise noted, statements about X always refer to both global and correspondingly restricted state spaces. The necessary generalization is carried implicitly in what follows.

2.13. What Can Already Be Described

Although the notation introduced so far has been deliberately kept minimal, it already allows a surprisingly precise description of very different historical constellations. Without further assumptions, both long-term developments and failed or unstable societal designs can be formulated.

Let us consider, by way of example, the area of present-day Belgium around the year 300. The available primitives S comprised simple forms of state administration, a rudimentary monetary system,

personal relations of rule, and local synchronization mechanisms. The resulting manifestation R consisted of loose administrative structures, strong local autonomy, and limited central control.

By contrast, Belgium around the year 2000 describes a state with a significantly altered S—state, bureaucracy, property, and money are technically, organizationally, and communicatively far more capable than 1700 years earlier. The resulting R is a highly differentiated welfare state with complex administration, a division-of-labor economy, and stable institutions.

Between these states lie not only gradual changes but also abrupt tipping points. Climatic upheavals, crop failures, or epidemics have repeatedly altered E so drastically in the past that existing combinations of S and R became unstable and transitioned into new states. The disintegration of late antique societal structures can be described in this model as a consequence of an environmental change that could no longer sustain the previous societal manifestations.

The model equally allows the analysis of failed or unstable societal designs. The project *Cybersyn* in Chile aimed at a societal manifestation R that envisioned a highly centralized, near-real-time economic control system. The primitives S available at the time—in particular computing power, communication, and data collection—were, however, not sufficiently developed to sustain this R in a stable manner.

The situation was similar with the surveillance ambitions of the GDR. The envisioned R of an omnisciently informed state exceeded

the capabilities of the analog S of that era. The attempt to compensate for this deficit organizationally led to enormous resource expenditure without achieving the desired stability.

Current developments can likewise be described in these terms. India was for a long time characterized by an E and an S that hardly permitted the formation of a strongly centralized, homogeneous nation-state. The current strategy of establishing a new R' with new primitives S'—in particular mobile communication, digital identity, and data-driven administration—can be read in this model as a deliberate attempt to make a previously unsustainable societal manifestation stable for the first time.

All of these examples require no additional concepts. They can be expressed entirely in the notation $x = (E, S, R)$. The model makes no claim to prediction or evaluation. It merely shows that even with a few structural distinctions, very different historical constellations become comparable and describable.

Concluding Question. If such different societal states are describable and comparable: What structure does the space X itself possess, and how can transitions, stability, and ruptures between states be formally captured?

3. The Topological Space X

3.1. Problem: States Without Structure

In the previous chapter, the set X of all societal states was introduced. Each element $x \in X$ is given by a triple

$$x = (E, S, R)$$

and describes a consistent societal constellation at a particular point in time.

This determines which states can exist. However, it does not determine in what relation these states stand to one another. In particular, it has not yet been formalized when two states are to be considered similar, when a change can be regarded as incremental, and when a qualitative rupture occurs.

Without an additional structure on X, history remains formally an unordered set of points. Statements about stability, change, or transitions can then only be made narratively, not with conceptual precision. There is no foundation for distinguishing between internal adjustments within an order and a transition to a different order.

What is sought, therefore, is a mathematical structure on X that describes relationships between states without making assumptions

about temporal sequences, velocities, or quantitative comparability. This structure should be minimal and contain precisely the information required for the analysis of historical orders.

3.2. Goal: Structure Without Measurement

The sought structure on X is intended to make relationships between societal states formally tractable without measuring these relationships. In particular, no assumptions about distances, directions, or temporal parameters are to be introduced.

For the analysis of historical orders, the decisive question is not how strongly two states differ, but whether they belong to the same order or not. A change can be extensive without leaving the order, or appear minor and yet mark a qualitative rupture. This distinction cannot be reliably captured by quantitative means.

The goal is therefore a structure that groups states according to their structural affinity. This structure should make it possible to identify sets of states within which adjustments are possible without requiring a fundamental reorganization.

At the same time, the structure should be sufficiently open so as not to force any statements about dynamics or stability. It describes exclusively which states belong together, not how or why transitions occur. It thus remains connectable to later concepts without anticipating them.

3.3. Open Sets as Societal Orders

To formally capture relationships between societal states, we introduce the concept of open sets on the space X.

An open set $U \subseteq X$ denotes a set of societal states that are structurally compatible with one another. Compatibility here means that transitions between states within U are possible through adjustments of the realizations R, without requiring a fundamental reorganization of the underlying primitives S.

Within an open set, environmental conditions E may change, and elements of S may shift as well, provided that these changes can be functionally absorbed in R. A state remains within the same open set as long as its societal order can be maintained through incremental internal adjustments.

Open sets thus represent societal orders in the formal sense. They group together states that, despite differing concrete realizations, follow the same structural logic. Changes within an open set do not constitute a change of order, but modifications within an existing order.

The assignment of a state to an open set is not a question of historical periodization, but a structural decision. Open sets are not necessarily temporally contiguous and are not bound to geographical spaces. They are defined exclusively by structural compatibility.

3.4. Robustness of Open Sets

Open sets are not to be understood as fragile constructs, but as robust regions of the state space X. Their definition permits a wide range of internal changes without necessitating a change of order.

Societies can absorb changes in environmental conditions E over extended periods without leaving their fundamental order. Likewise, elements of the primitives S may change or expand, as long as these changes remain functionally compatible with the existing realizations R.

This robustness explains why societies can frequently process structural change in a delayed manner or seemingly ignore it. As long as adjustments within R suffice, the state remains within the same open set, even if the boundary conditions have already shifted considerably.

A change of order becomes necessary only when no further internal adjustment is possible. In this case, the open set loses its capacity to sustain the state in question. This transition marks not a gradual step, but the departure from the previous order. The formal description of this transition will be made precise in the following chapters.

3.5. Empty Set and Total Space

The structure that we introduce on the set X is based on a collection of subsets that we designate as open sets. This collection must contain two special elements: the empty set and the total space X.

The empty set $\emptyset$ is a subset of X that contains no states. It has no substantive meaning in terms of societal orders or historical constellations. Its existence is exclusively a formal consequence of the chosen structure.

The total space X itself is likewise included as an open set. It encompasses all societal states regardless of their structural compatibility. This set, too, does not describe a concrete order, but represents the maximal aggregation of all possible states.

The inclusion of $\emptyset$ and X serves not interpretation, but the formal closure of the structure under consideration. It ensures that the collection of open sets is completely defined under the operations considered in what follows.

3.6. Union of Open Sets

The structure of open sets on X must be closed under the formation of unions. This means: for every family of open sets $(U_i)_{i \in I}$, their union

$$\bigcup_{i \in I} U_i$$

is again an open set. Concretely: if a union $U = U_1 \cup U_2$ is formed, then U contains all states that belong either to the order U_1 or to the order U_2. No new order is defined; rather, a common level of consideration for several existing orders is established.

The union operation makes no statement about transitions between the united sets. It allows different societal orders to be subsumed under a common overarching concept and permits the examination of historical constellations at different levels of abstraction. It serves abstraction, not dynamics.

3.7. Intersection of Open Sets

The structure of open sets on X must be closed under finite intersections. This means: if $U_1, \ldots, U_n$ are open sets, then their intersection

$$\bigcap_{k=1}^{n} U_k$$

is also an open set. The intersection describes states that belong to several orders simultaneously—constellations in which different structural logics are effective at the same time. Such hybrid states are neither exceptions nor unstable by definition, but formally well-defined. The intersection describes not movement between orders, but their simultaneous validity.

3.8. Topology and Topological Space

In mathematics, a topology denotes a formal structure that specifies which subsets of a given set are to be regarded as open. A topology is not bound to distances, measures, or directions. It specifies exclusively which elements may be considered as belonging together.

Formally, a topology on a set X consists of a family of subsets of X that satisfies three properties: the empty set and the total set X belong to it, arbitrary unions of these subsets likewise belong to it, and finite intersections likewise belong to it.

In the preceding sections, precisely such a structure was constructed. Starting from the set X of all societal states, certain subsets were distinguished as open: those that group together structurally compatible states. It was shown that these open sets contain the empty set and X, are closed under unions, and remain closed under finite intersections.

Thus a topology on X is established.

The set X together with this topology is called a topological space. This space contains no information about temporal sequences or causal mechanisms. It describes exclusively which societal states can be thought together, which are structurally compatible with one another, and which are not.

Concretely, this means: the topological space makes it possible to treat societal orders as connected regions, to describe transitions

as changes between such regions, and to formally identify incompatibilities—without already making statements about dynamics, velocity, or direction.

The topological space thus constitutes the structural framework within which historical development can be addressed with precision in the first place.

3.9. Why No Further Structure

The topological space describes exclusively structural neighborhoods between societal states. It makes no statements about how far apart two states are, in which direction a development proceeds, or how quickly it takes place.

In particular, the space X is not a metric space. A metric would presuppose that distances between societal states can be meaningfully and uniquely measured. This would imply that different dimensions of E, S, and R are comparable, weightable, and addable. For societal states, however, there is no canonical scale on which such distances could be determined.

Likewise, X is not a vector space. A vector space presupposes that states can be linearly combined and that meaningful operations of addition and scaling exist. For societal states, however, there is no well-defined operation that would allow two orders to be merged into an average or an order to be continuously interpolated.

The renunciation of metric or algebraic structures is therefore not a deficiency, but a deliberate methodological decision. Any additional structure would enforce assumptions about comparability, linearity, or proportionality that are historically unjustifiable.

The topology represents the minimally necessary mathematical structure for speaking precisely about societal orders, their affinity, and their demarcation. All further concepts are introduced only where they are substantively necessary and formally justified.

3.10. Epochs, Upheavals, and Structural Orders

The concepts introduced so far already make it possible to describe central historical phenomena with precision. In particular, historical epochs, upheavals, and transitional phases can be formally captured without recourse to event-centered narratives.

Historical epochs can be understood as open sets. They encompass families of societal states that are structurally compatible. Within such an open set, concrete realizations of R may change without the fundamental order being abandoned. Reforms, crises, and shifts in power are then internal movements within the same open space.

A historical upheaval occurs not where particularly much happens, but where the existing order can no longer be structurally continued. Topologically, this means that there is no longer an open set containing both the previous state and its continuation.

The upheaval then appears as an abrupt change, even though its preconditions have frequently developed over the long term.

The introduction of the printing press offers an illustrative example. For a long time, the new technical possibilities of printing existed alongside the established institutional and cultural structures. This phase can be described as an intersection of open sets: states in which old and new logics are simultaneously effective. Neither had the Middle Ages ended abruptly, nor was the early modern period already established.

Only when the structural compatibility between the mass dissemination of texts and the existing orders could no longer be maintained did a rupture occur. The Reformation marks not an origin, but a point of visible destabilization. The actual upheaval lies in the impossibility of continuing to extend the previous order incrementally.

The union operation makes it possible to consider different epochs or orders jointly at a higher level of abstraction. Thus very different historical states can be subsumed under a common overarching concept, provided they need not be further distinguished for a given question. The intersection, by contrast, makes it possible to precisely identify hybrid constellations in which several ordering logics hold simultaneously.

This makes clear: even without statements about dynamics or time, the topological approach allows historical continuity, upheavals, and transitional phases to be clearly distinguished and formally

identified. The concepts of open set, union, and intersection suffice to capture central structures of history with precision.

Concluding Question. The topology developed so far describes which societal states belong together and how orders are demarcated from one another. It distinguishes open spaces, their unions, and their overlaps, without making statements about development or causation.

Yet even without dynamics, a further question arises: which of these orders are stable, where do their boundaries lie, and how can it be formalized that states accumulate at certain structures or fail at them?

4. Continuity, Convergence, and Boundary Surfaces

4.1. Problem

The topology developed so far describes which societal states belong together and which orders are demarcated from one another. Open sets group structurally compatible states; their unions and intersections permit abstraction and superposition. This structure is entirely static.

What this description does not yet capture, however, is stability. The topology alone does not distinguish between orders that can persist over long periods and those that occur only briefly. It makes no statement about whether states accumulate within an order, whether they cluster at its boundaries, or whether certain configurations are structurally favored.

Historically, this distinction is central. Some societal orders prove extraordinarily long-lived; others disintegrate rapidly or remain unstable. These differences cannot be explained solely by membership in an open set.

To describe these phenomena precisely, additional concepts are needed that lie within the topology itself. These concepts must capture stability, demarcation, and structural proximity without

already making claims about causes, temporal trajectories, or dynamics.

The aim of this chapter is therefore to introduce the necessary topological concepts with which stability and boundary regions of societal orders can be described, before the subsequent step turns to the driving forces of change.

4.2. Closed Sets

In a topological space, closed sets are not defined independently but as complements of open sets. If $U \subseteq X$ is an open set, then its complement

$$X \setminus U$$

is a closed set.

Applied to the space of societal states considered here, this means: for every open set describing a particular order, there exists a closed set comprising all states that no longer belong to that order. The closed set thus marks the exterior of the validity of the order in question.

Closed sets in this model are negatively defined. They are not described by intrinsic properties but solely by their demarcation from an open set. Accordingly, they are largely indeterminate and epistemically inaccessible. As a rule, a closed set encompasses a predominant portion of X, since open sets describe only a very small, structurally coherent segment of the entire state space. It

is neither necessary nor possible to fully characterize the states contained in a closed set.

The function of closed sets lies not in their substantive analysis but in their bounding effect. They define where an order ends without making claims about what lies beyond that boundary. Closed sets are neither target spaces nor descriptions of future states; they are formal markers of the structurally non-belonging.

Closed sets thereby enable a precise distinction between states that can be meaningfully described within an order and those that lie outside its domain of validity. They form the necessary prerequisite for formally capturing boundary regions and transition zones.

4.3. Boundary and Boundary Surfaces

For every subset $U \subseteq X$, the topology allows the definition of its boundary. The boundary of a set U, denoted ∂U, consists of precisely those states that lie neither unambiguously in the interior of U nor unambiguously outside of U.

Formally, the boundary of a set is defined as the difference between its closure and its interior. It comprises those points in whose neighborhood both states from U and from its complement can be found.

Applied to societal orders, the boundary describes the border region of an open set. These are states that still belong to the order but where conditions already arise that are only partially compatible

with it. The boundary is thus the transitional zone between the interior of an order and its structural exterior.

In contrast to closed sets, the boundary is formally still part of the describable state space. Topologically, it can be approximated by states from the interior of an order. In this sense, the boundary is accessible.

In practice, however, boundary states frequently prove epistemically unstable. Precisely where an order reaches its structural limits, the concepts and institutions with which it describes itself collapse. Boundary states thus often constitute mathematical singularities of the model: they are formally definable yet resist stable substantive description.

The boundary, however, does not yet describe a transition or a movement. It merely marks that an order loses its full validity. Whether states at the boundary are stabilized, drawn back, or abandoned cannot be decided by the concept of boundary alone. It identifies the locus of structural tension, not its resolution.

4.4. Convergence

In a topological space, convergence denotes the property of a sequence or net of points approaching a particular point. The concept of convergence presupposes no metric and makes no claims about distances, speeds, or temporal processes. It describes exclusively a structural approximation within the space.

Applied to societal states, convergence means that different states align in their structure and accumulate in the vicinity of certain configurations. This approximation is purely formal: it describes that states increasingly exhibit similar structural properties, without explaining why this occurs or whether the process is complete.

Formally, convergence in the topological sense means the following: There exists a sequence of societal states

$$(x_i)_{i \in \mathbb{N}}, \quad x_i \in X,$$

and a state $x \in X$, such that for every open neighborhood U of x, from some index N onward all terms of the sequence lie in this neighborhood,

$$\exists N \in \mathbb{N}\, \forall i \geq N : \; x_i \in U.$$

This definition makes no claim about what gives rise to the sequence, in what order or at what speed it is traversed, or whether it can be interpreted temporally. It describes exclusively a structural approximation in the space of states.

Convergence is thus a concept of stability, not of dynamics. A state toward which many other states converge is structurally favored, without any cause or goal being derivable from this. Convergence describes a pattern, not a movement.

Historically, convergence can be observed in the formation of stable societal orders. Different initial states can, over the course of their development, approximate similar institutional, organizational, or

legal structures without this approximation being centrally planned or consciously pursued.

It is important to note that convergence makes no claim about endpoints. It is not required that a state be reached or fixed. What matters is solely that states structurally concentrate in certain regions of the topological space.

The concept of convergence thus makes it possible to describe stability within an order without already making claims about transitions, ruptures, or driving forces. These are introduced only in later chapters.

4.5. Continuity

In topology, continuity describes not a movement but a structural compatibility of transitions. A mapping between topological spaces is continuous if open sets are pulled back to open sets.

Formally, this can be stated as follows: A transition between states is continuous if for every considered state $x \in X$ and every open neighborhood U of x, all sufficiently small variations of the state likewise lie in U.

Topologically, this means that there is no well-defined smallest change. Instead, arbitrarily fine gradations of states exist within the same open set. "Infinitely small steps" are, in this sense, not measurable distances but arbitrarily fine structural modifications that do not leave the membership in the order.

Applied to the space of societal states considered here, continuity means: A transition between states is continuous if and only if small structural variations remain within an order. As long as states move only within the same open set, the fundamental order is preserved.

Continuity thus describes incremental change. Institutions are adjusted, practices altered, rules modified, without the underlying steering mechanisms or environmental conditions being fundamentally called into question. Historically, this corresponds to reforms, optimizations, and gradual transformations within an epoch.

Non-continuous transitions, by contrast, are ruptures. They leave every open neighborhood of the initial state and lead into a different order. Such transitions cannot be described as continuations of existing developments. They mark structural discontinuities at which existing categories lose their explanatory power.

The concept of continuity thus makes it possible to distinguish precisely between change within an order and change of the order itself. It reveals that many historical processes deliberately aim at continuity, while upheavals are characterized precisely by the fact that continuity can no longer be maintained.

4.6. What These Concepts Make Visible

Closed sets mark the exterior of an order without positively describing it. A peasant subsistence society is an open set; all states in which division of labor, markets, or state administration play a

supporting role—as well as brain-to-chip interfaces—belong to its closed set, without these states needing to be individually characterized.

Boundary surfaces mark where an order loses its internal consistency. A pre-modern agrarian society can absorb population growth, climate fluctuations, or local innovations over long periods. Only when these changes can no longer be accommodated within existing structures is the boundary reached. It marks not the transition but the end of reformability.

Convergence describes the fact that very different societies can structurally approximate similar states without this approximation being goal-directed. The clearest historical example is the formation of the modern nation-state: despite entirely different cultural, religious, and political starting conditions, territorially delimited states with centralized administration, uniform legal systems, and monopolized claims to the use of force emerge everywhere. This order functions as a convergent attractor in the space of societal states, without its causes or historical necessity being thereby explained.

Singularities denote states at which the distinctions between stability, boundary, and exterior collapse. At a singularity, no open neighborhood permitting order exists any longer. Historically, such situations manifest as phases of extreme disorder: the collapse of central institutions, massive violence, or the loss of fundamental coordination mechanisms. The singularity is not incomprehensible because knowledge is lacking, but because the order itself no longer provides a viable structure.

Together, these concepts make it possible to precisely distinguish stability, exhaustion, capacity for reform, and structural collapse—and they reveal where societal descriptions necessarily reach their own limits.

4.7. How This Also Describes Organizations

The model developed so far is not restricted to entire societies. Every societal state $x \in X$ can be restricted to arbitrary subsets of society. In addition to regional or temporal focalizations, application to organizations is particularly possible.

Organizations can in this sense be described as distinct states, embedded in a superordinate societal order. They too possess an environment E, steering and coordination mechanisms S, as well as concrete institutional configurations and practices R. A company, a government agency, or a political party can therefore be modeled as its own $x = (E, S, R)$.

The topological concepts introduced above thereby become immediately applicable to organizations. Open sets describe phases of stable organizational order in which processes, roles, and decision-making pathways are coherently aligned. As long as this order holds, organizations can develop continuously—through reforms, optimizations, or incremental adjustments, for example.

Convergence at the organizational level describes recurring structural approximations that occur independently of specific goals, individuals, or historical contexts. These include, for instance, the

tendency toward bureaucratization, the expansion of administrative functions, the displacement of ends by means (goal displacement), the formation of latent functions, unintended side effects, and the emergence of organization-specific oligarchies.

These phenomena are not primarily to be understood as pathological developments. Rather, they follow from the internal logic of institutional reproduction under stable framework conditions. Organizations develop structures that secure their own continued existence, stabilize decision-making processes, and reduce complexity. From the topological perspective, these developments appear as convergence movements within stable open sets.

Concepts such as Parkinson's law, goal displacement, or organizational oligarchization thus describe not singular pathologies but typical movements in the state space of organizations. They mark attractors toward which very different organizations can converge, as long as their environmental conditions and steering mechanisms remain essentially constant.

Boundary surfaces, by contrast, mark situations in which organizational orders lose their viability. This can occur, for example, through overcomplexity, goal displacement, or external changes in the environment. At these boundary regions, continuous adaptation becomes increasingly impossible. Decisions lose their effectiveness, feedback mechanisms fail, and the organization enters a state of heightened instability.

Continuity at the organizational level thus separates reform from rupture. As long as changes remain within an open set, the organi-

zation can preserve its identity. If, however, a boundary surface is crossed, non-continuous transitions occur: restructurings, power shifts, splits, or collapses. These transitions are structurally comparable to societal upheavals but occur at a smaller scale.

The application of the model to organizations demonstrates that societal topology is not only macro-historically relevant. The same concepts capture transitions, stabilities, and ruptures at different levels of social order. Organizations thus appear not as special cases but as locally focused instances of the same structural space.

Concluding Question. The topological analysis has shown how societal states are structured, where orders hold, where they end, and how reform, exhaustion, and rupture become formally distinguishable. It describes, however, exclusively the form of the space, not its movement.

This leaves a central question open: Why do societies approximate certain orders, why do they persist in stable states over long periods, and under what conditions do they leave these states again? The topology describes where transitions are possible or impossible but does not explain why they occur.

This question leads beyond structure and demands an additional concept.

5. X as a Nondeterministic Automaton

5.1. Motivation: From Structure to Movement

The topological description of societal states developed so far makes it possible to precisely distinguish orders, their stability, and their boundaries. Open sets describe coherent orders, boundary surfaces mark their exhaustion, continuity separates reform from rupture. These concepts explain where transitions are possible or impossible.

What they do not explain, however, is why transitions occur at all.

The topological space X is structural but inert. It contains no statement about why a society leaves a state x even though that state may still be stable, or why it undergoes a transition to another state x' even though this transition involves risks, losses, or uncertainty. Topology describes possibilities, but not movement.

Historically, this gap is decisive. Societies often persist in orders over long periods even though alternatives exist. In other cases, they undergo abrupt transitions even though existing structures still appear functional. Neither stability nor instability alone explains these decisions.

The concept of convergence is also insufficient here. Convergence describes approximation but not drive. It makes visible that states

accumulate, yet does not explain why this accumulation arises or why it translates into movement.

What remains missing is a formal description of historical movement. In particular, it remains open how a concrete historical trajectory emerges from several structurally possible successor states.

An obvious approach would be to introduce an explicit time variable t and a time-dependent dynamics. Societal development could then be modeled as a trajectory in state space.

This approach is formally possible but proves conceptually weak for historical description. Physical time is continuous, homogeneous, and externally given. Historical development, by contrast, is discontinuous, state-dependent, and characterized by long phases of persistence as well as short phases of rapid reordering. A uniform temporal grid carries no additional explanatory power here.

Attempts to discretize time lead either to arbitrary divisions or merely reproduce the sequence of already identified state changes. Time is then not explained but derived from the sequence of states.

For this reason, a different approach is taken in what follows. Movement is described not as a function of time but as a sequence of state transitions. The focus shifts from a time-parameterized dynamics to a structural description of possible transitions and their realization.

Historical development thus appears as a path through a discrete state space. Time arises implicitly from the sequence of realized transitions, not as an independent model variable.

5.2. The State Space as a Nondeterministic Automaton

The space of societal states X is interpreted in the following as a nondeterministic finite automaton (NFA). This modeling makes it possible to describe movement without an explicit time variable and without deterministic transition rules.

A state $x \in X$ represents a coherent societal order in the topological sense developed previously. Transitions between states are not uniquely determined but understood as a set of possible successor states. Formally, the automaton consists of:

- a finite set of states X,
- a transition relation

$$\Delta \subseteq X \times X,$$

- and a distinguished initial state $x_0 \in X$.

For every state $x \in X$:

$$\Delta(x) = \{x' \in X \mid (x, x') \in \Delta\} \neq \emptyset.$$

The set of possible successor states is thus never empty. The model admits no final states and no end of history. Societal development may stagnate, oscillate, or transform, but it does not terminate.

This non-emptiness is ensured in particular by self-transitions. For every state x,

$$(x, x) \in \Delta$$

is admissible. Persistence is thereby modeled not as absence of movement but as an explicit transition.

The automaton is nondeterministic: from a state x, no uniquely determined next state follows. Multiple transitions may be simultaneously admissible without the model specifying which of them is realized.

The automaton contains no time, no assumption of progress, and no evaluation function. It describes exclusively which transitions are structurally possible. Which of these possibilities are realized remains initially open.

The NFA thus constitutes the minimally structured description of historical movement: it captures openness, nondeterminism, and stability without making additional assumptions about causes, goals, or velocities.

5.3. From the Transition Relation to the Markov Chain

The nondeterministic automaton describes which transitions between societal states are possible. It contains, however, no statement about how plausible or frequent these transitions are. All admissible transitions are initially on equal footing.

To describe historical movement more closely, the transition relation Δ is now equipped with probabilities. This transforms the nondeterministic automaton into a Markov chain.

Formally, each transition $(x, x') \in \Delta$ is assigned a transition probability

$$P(x \to x') \in [0, 1]$$

such that for every state $x \in X$:

$$\sum_{x' \in \Delta(x)} P(x \to x') = 1.$$

The probabilities are state-dependent but not time-dependent. The Markov property means: the probability of the next state depends exclusively on the current state x, not on the previously traversed path.

Historical movement is thereby modeled as a stochastic process. From a state x, several possible successor states follow, but with differing probabilities. The self-transition $x \to x$ also receives an explicit probability, modeling persistence within an order.

It is important that these probabilities do not represent conscious decisions. They are not rules of action, not preferences, and not goals. They merely condense structural inertia, institutional stability, and the implicit forces that favor or inhibit a transition.

The Markov chain thus describes not what ought to happen but how societal states typically continue under given structural conditions. It provides a formal language for historical plausibility without producing determinism.

At the same time, the model remains open: the Markov chain describes a distribution of possible futures, not a single trajectory. Which of these possibilities is realized remains undetermined.

5.4. Societal Pressure and Constant Transition Probabilities

The introduction of a Markov chain suggests thinking of transition probabilities as variable. Intuitively, the impression arises that societal pressure accumulates: the longer a society persists in a state, the more probable a transition to another state y seems.

This intuitive picture is, however, mathematically misleading. In the modeling used here, the transition probabilities

$$P(x \to y)$$

are constant. They do not change with the number of steps already traversed and do not depend on the past. Time arises not through a

change of weights but exclusively through the continued progression of the chain.

This raises a central question: how can empirically observable societal pressure be modeled if the transition probabilities themselves remain invariant?

The answer is that pressure is modeled not as memory of the dynamics but as a component of the state space.

To this end, we introduce a relation

$$\sim \subseteq X \times X$$

expressing *structural equivalence*. Intuitively, $x \sim x'$ holds when both states realize the same societal order in the sense of S and R and are thus assigned to the same open set, yet may differ in internal tension parameters that arise within this order.

Formally, this can be captured by assuming a mapping

$$\pi : X \to \mathcal{O}$$

that assigns to each state a form of order (for instance, the open set it represents), and defining

$$x \sim x' \quad :\Longleftrightarrow \quad \pi(x) = \pi(x').$$

The equivalence class

$$[x] := \{x' \in X \mid x' \sim x\}$$

then describes all states that carry the same order.

Within such a form of order, however, a state varies further. We therefore supplement a pressure coordinate

$$\delta : X \to D,$$

where D is a suitable ordered set (for example, $D = \mathbb{R}_{\geq 0}$ or a partially ordered space). Then

$$x \sim x' \quad \text{and} \quad \delta(x') > \delta(x)$$

means that x' describes structurally the same order as x but with higher internal tension, overload, or instability.

Societal persistence is thus to be modeled not as a self-transition $x \to x$ but as a transition

$$x \to x' \quad \text{with} \quad x \sim x' \ \text{and typically} \ \delta(x') \geq \delta(x).$$

From a structural point of view, the society remains in the same order but moves within this order through states of increasing tension.

The Markov property is thereby fully preserved. Pressure is not memory of the dynamics but part of the current state. Transition probabilities continue to depend only on the present state—in particular on $\pi(x)$ and $\delta(x)$—not on the number of prior sojourns.

Societal pressure is thus neither an external counter nor an additional time variable. It is an explicit state component. Time

appears as progression through the state space, even when the societal order does not change but merely its internal strain increases. Transitions at boundary surfaces arise not through variable probabilities but because, within an order, states are reached for which other transitions are already more probable in the model.

5.5. Transitions Without a Target State

Societal transitions cannot meaningfully be understood as a search for an optimal state. Historical development follows no knowledge of a goal and no logic of global optimization. Societies move not because they know where they want to go but because persistence in the existing state becomes increasingly implausible.

Movement arises not from knowledge of a goal but from comparison. A transition from a state x to a state x' becomes more probable when x' appears more viable than x under given or expected conditions. This assessment need be neither explicit nor conscious. It can be local, partial, and contradictory, arising in a distributed fashion across many actors.

The analytical focus thereby shifts from states to transitions. Not the state itself explains historical change but the relation between two states. Movement arises where existing orders lose their plausibility and alternative constellations become relatively more connectable.

This connectivity is not normative. It implies no progress, no moral improvement, and no goal of history. It describes merely a

directed tendency: under comparable circumstances, the transition to another state appears more probable than remaining in the existing one.

In the Markov modeling, this logic manifests not as a decision rule but as a weighting of transitions. The transition probabilities encode which movements are typically plausible under given structural conditions, without determining which transition is realized.

5.6. Fitness as a Relational Reading of Transitions

The Markov chain assigns probabilities to possible state transitions. These probabilities are initially purely formal: they indicate how frequent or plausible a transition is under given structural conditions, without interpreting it substantively.

One possible interpretation of these transition probabilities consists in reading them as an expression of a relative *fitness* of transitions. Fitness here designates no additional mathematical structure and no independent dynamics, but an interpretation of the already introduced probabilities.

In this sense, a transition from x to x' is fitness-compatible when it is assigned a comparatively high probability

$$P(x \to x').$$

Fitness describes no absolute quality of a state but a relational preference among possible successor states. Fitness is not a dynamics, but it marks the direction in which transitions become systematically more probable under given conditions.

Crucially, this preference remains strictly local. The Markov chain does not order states globally and defines no optimum. It evaluates exclusively the reachable neighborhoods of a current state x. There exists neither a best state nor a target point of societal development.

In this reading, directed movement arises without introducing a teleology. Transitions are not chosen but merely rendered differently plausible. High fitness implies no necessity and low fitness no prohibition.

The transition probabilities represent neither conscious decisions nor rational calculations. They condense structural inertias, institutional stabilities, technological constraints, and implicit power relations into a stochastic pattern.

No concrete form of F is specified. The relation may imply arbitrary criteria—such as productivity, stability, power, viability, or other evaluative standards. The model remains deliberately agnostic with respect to the substantive content of the fitness relation.

The existence of a fitness relation suffices to model directed movement in the state space. Whether a transition is actually realized remains undecided. The fitness relation describes a driving force, not a dynamics. It explains why certain transitions appear more

probable than others without determining which transition is actually realized.

The nondeterminism of the model is fully preserved. The Markov chain bounds the space of possible futures without reducing it to a single path. Fitness acts as directional guidance, not as determination.

5.7. What Fitness Is Not

To avoid misunderstandings, it is necessary to clarify explicitly what fitness does *not* mean.

The introduction of a fitness relation might suggest that societal change follows a deterministic optimization process. Were this the case, a society would at every point blindly choose the transition promising the highest immediate fitness gain. Historical development could then be described as a greedy algorithm or a hill-climbing procedure that always optimizes locally.

Such determinism is, however, neither empirically tenable nor theoretically necessary. The fitness relation is not a decision rule but an evaluative relation. It does not order transitions uniquely and does not produce a singular next future. In nearly all realistic situations, several simultaneously fitness-compatible successor states exist that appear viable under given conditions.

First, fitness is not a global optimization function. It does not order states absolutely and defines no maximum. There exists no

best state and no goal of history. The Markov chain explicitly produces no ranking on X but merely local preferences among reachable successor states. Societal development thus follows no optimization problem.

Second, fitness implies no teleology. That a transition is more probable than another does not mean it is necessary, meaningful, or historically intended. Fitness describes directed tendencies, not purposes. The model admits no conception of a goal, no concept of progress, and no normative direction.

Third, fitness is not a decision rule. The transition probabilities represent no conscious decisions by actors, no collective rationality, and no aggregated will. They condense structural conditions, not intentional acts of choice. In the model, societies do not act—they move.

Fourth, fitness is not a dynamics. It determines neither when a transition occurs nor how quickly it proceeds. The temporal structure of history arises exclusively through the realized path, not through a time-dependent change in probabilities.

Finally, fitness is not a cyclical principle. The model contains no counter, no phase, and no logic of recurrence. That societies remain in similar states over long periods or repeatedly encounter similar boundary surfaces is not the expression of a cycle but the result of structural similarity in the state space.

Fitness thus explains not *what* ought to happen but merely *why* certain transitions appear more plausible than others under given conditions. It constrains possibilities without determining them.

5.8. The Realized Historical Path

The concepts introduced so far describe the space of possible societal developments. The nondeterministic automaton defines which transitions are in principle admissible. The Markov chain assigns probabilities to these transitions.

Both together, however, do not yet describe history itself but merely its possibility space.

The actual human past is a single, concretely realized path through this space. Formally, it is a sequence

$$(x_0, x_1, x_2, \dots),$$

where for each i, the transition

$$x_i \to x_{i+1}$$

is permitted in the automaton and assigned positive probability in the Markov chain.

This path is neither necessary nor optimal. It is one realization among many possible ones. Other paths would have been possible under the same structural conditions but were not realized. History is thus not an object of the model but a result of its application.

It is important that the realized path possesses no additional structure. It contains no information about which alternatives existed, which transitions were narrow, or which developments

nearly occurred. All of this is visible only in the model, not in the realized trajectory itself.

Historical time arises in this framework not through an external clock but through the progression along this path. Time is the ordering of states, not an additional parameter.

5.9. Retrospective Determinism

The realized historical path creates, in retrospect, the impression of necessity. Once a sequence of states has occurred, it appears as without alternative, while unrealized transitions vanish from the historical account.

This necessity is not a structural feature of the model but an effect of narration. The realized path contains no information about which alternatives existed or how probable they were. Contingency is replaced by causality in retrospect.

The model separates these levels explicitly. Structurally, there always exists a space of possible transitions with differing probabilities. Historically, exactly one path is realized. Narratability arises only after this selection.

Determinism is thus not an ontological but a narrative phenomenon. History is directed and stably describable without being necessary or teleological.

5.10. What This Model Does Not Accomplish

The model is deliberately kept minimal. It is not teleological: there is no target state and no measure of progress. It is not deterministic: even transitions with high probability need not be realized. It is not cyclical: recurring patterns may appear but are not structurally enforced. It does not describe actor decisions: transition probabilities are not preferences but condensed structural inertia. And it is not a complete dynamics: when and how quickly a transition occurs remains open.

5.11. What One Can Think With This

With the modeling of societal development as a path through a nondeterministic state space, the perspective shifts from states to transitions. What is decisive is not how a state is constituted but which transitions from it are plausible, blocked, or improbable. Historical movement arises where persistence in the existing state loses plausibility relative to reachable alternatives. Not knowledge of a goal drives history, but comparison.

The model furthermore allows different approaches in the philosophy of history and the social sciences to be situated on a common formal level. Economic, political, cultural, or normative theories do not describe different historical worlds but different weightings of the same transition space. They explain why certain transitions were considered plausible and others were not—without any of

these perspectives being able to uniquely determine the historical path.

The model thus strictly separates the space of the possible, the distribution of the plausible, and the one realized trajectory. It allows one to think of history as directed yet open: not arbitrary, but also not necessary.

Concluding Question. The model describes how historical development arises as a path through a space of possible states, without determinism or goal assumptions. It does not yet explain, however, why certain transitions are favored, delayed, or prevented.

How are the direction and velocity of societal movement determined within this framework? Which mechanisms stabilize orders, which drive transitions forward, and why do historical changes proceed neither arbitrarily nor uniformly?

6. Direction and Speed of Societal Movement

6.1. The Problem of Realization

By modeling societal development as a nondeterministic automaton and as a Markov chain, we have described which transitions between societal states are structurally possible and how plausible each of these transitions is.

This, however, does not yet explain how societies actually move.

In particular, two questions remain open. First: If multiple successor states with positive transition probability are reachable from a given state, what determines which of these states is realized? Second: What determines the speed of societal movement, and why does change occur neither arbitrarily fast nor remain permanently absent?

The nondeterministic automaton describes openness, the Markov chain structural plausibility; together they suggest possible developments but enforce no concrete trajectory.

Historically, this gap is central. Societies often persist in existing orders over long periods, even though other states would be reachable and plausible. In other situations, abrupt transitions occur whose concrete direction and speed cannot be explained by transition probabilities alone.

What is therefore needed is an additional conceptual framework that describes how concrete historical movement arises from structural possibility and probabilistic plausibility: how direction and speed emerge within an open, nondeterministic process.

6.2. Direction Without Knowledge of Destination

When multiple successor states with positive transition probability are reachable from a given state, the question arises in which direction a society actually moves.

This direction does not result from a selection among explicitly compared alternatives. Societies do not move by weighing possible futures and consciously deciding on one of them. They act, administer, produce, communicate, and react within their existing order.

From this continued operation, a transition to a new state emerges without that state having been formulated as a goal or consciously pursued as a development. Direction is thus not the result of a decision but an emergent outcome of ongoing self-coordination.

Millions of local adaptations, routines, and feedback loops interlock. Certain developmental paths reinforce themselves; others lose their capacity for connection. The realized transition often appears necessary in retrospect, yet prospectively it was only one of several plausible possibilities.

This self-coordination presupposes neither a deliberative public sphere nor centralized will-formation. It may manifest in explicit discourses, but equally in implicit practices, institutional rules, power relations, or informal norms. Highly centralized systems can also be described within this framework; they do not constitute a special case but rather an extreme point among possible forms of coordination.

Direction thus emerges within the possibility space opened up by the automaton and the Markov chain, yet it is not determined by an evaluation rule. Transition probabilities constrain which developments are plausible. Which of these are realized follows from the internal logic of the existing order itself.

6.3. Speed as a Structural Property

In addition to direction, the question of the speed of societal movement arises. Even when transitions are structurally possible and probabilistically plausible, it does not follow that they occur immediately or quickly.

Societal orders possess a pronounced capacity for persistence. They reproduce their own structures, roles, and expectations over long periods of time. This persistence is not a passive state but the result of active stabilization: rules are applied, routines repeated, institutions maintained.

In the model, this corresponds to transitions in which a state passes into structurally similar or nearly identical states. As developed

in the previous chapter, this is formalized by the equivalence relation

$$x \sim x'$$

which expresses that both states realize the same order.

Speed is therefore understood not as movement along a time axis but as a structural property of the transition sequence. A society changes slowly when many transitions occur within the same equivalence class $[x]$. It changes rapidly when transitions to states $x' \not\sim x$ that lie outside the existing order become more frequent.

Stability possesses intrinsic value in this regard. It enables predictability, coordination, and planning. Roles, expectations, and obligations gain significance only when they are reliable over a certain duration. An order that immediately realizes every new possibility undermines its own capacity for connection.

At the same time, speed cannot be reduced arbitrarily. If the environment E changes or internal pressure accumulates through the pressure coordinate δ over extended periods, permanent persistence can itself become destabilizing. Adaptation is then not prevented but merely delayed, which accelerates and intensifies later transitions.

Societal movement is therefore not a one-dimensional optimization but an ongoing balance between stabilization and change. This balance arises from the internal mechanisms of the existing order, not from an external dynamic.

6.4. Formal Structure of Movement

Societal development appears as a sequence

$$x_0 \to x_1 \to x_2 \to \dots,$$

where each transition $(x, x') \in \Delta$ is structurally permitted and assigned a positive probability $P(x \to x') > 0$. If $x \sim x'$, the society moves within the same order; if $x' \not\sim x$, a structurally relevant transformation is present. Direction and speed emerge from the structure of the transitions themselves. Time is not an independent variable but arises implicitly from the traversal of the sequence.

6.5. Societal Expectation Formation

For a concrete transition to arise from structural possibility and probabilistic plausibility, societal processes are required that stabilize, attenuate, or block expectations.

These processes operate within the existing order. They determine which possible successor states appear practically connectable and which remain unrealized despite structural possibility.

Societies do not explicitly distinguish among all reachable states. Instead, an implicit expectation landscape forms: some states are speculated about, experimented with, or anticipated; others

receive little or no attention. Frequently, the only actively stabilized expectation horizon is the continuation of the current state itself.

This expectation formation is not necessarily a conscious process. It manifests in discourses, institutions, routines, power relations, or physical control. The model presupposes neither language nor deliberation.

Societal feedback loops operate in a dual manner. They constrain direction by practically admitting only a subset of reachable states. At the same time, they influence speed by delaying, accelerating, or stabilizing transitions in self-transitions.

In limiting cases, these feedback loops can collapse or spiral out of control. Over-stabilization leads to de facto standstill; over-dynamization leads to disorientation. Between these extremes, every society continuously negotiates its own capacity for movement.

Societal change is thus neither the result of a plan nor mere chance. It arises from the coupling of structural possibility, probabilistic plausibility, and societal expectation formation.

6.6. Locating Discourse Within the State

The dynamics of societal expectation formation have so far been described as a process that reinforces, attenuates, or blocks transitions. What was explicitly missing, however, is the question of where this societal discourse is located within the model.

This localization is not optional. It is structurally necessary.

Societal discourse cannot lie outside the state space, nor can it be an additional mechanism alongside the automaton or the Markov chain. Were it external, it would influence transition probabilities without itself being part of the state. This would violate the Markov property and introduce an implicit memory structure.

Discourse must therefore be part of the current state x.

More precisely: it is a component of the institutional, semantic, and normative embedding $R(x)$. Discourse describes which states are describable, conceivable, and legitimizable; which transitions appear connectable; and which expectations are stabilized or delegitimized. All of these are not transitions but structural properties of the existing order.

It follows that discourse does not take place *between* states but *within* them. It is not a motor of movement but part of the order from which movement emerges.

When discourse changes, the state x itself changes. And only thereby do the transition probabilities to possible successor states x' change. The dynamics remain Markovian: transition probabilities depend exclusively on the current state, not on the history of discourse.

This clarification completes the model. Societal change does not arise from an external debate about futures but from the internal structure of an order that determines which futures become plausible from within it.

6.7. Analytical Scope

The model developed here provides neither an explanatory program nor a historical theory. It supplies a formal structure within which very different approaches can be described on the same level.

Different theories of societal change can be read as different weightings within the same transition space. Productivity, power, stability, security, ecological resilience, or institutional reproductive capacity appear not as competing explanations but as different perspectives on the same structure.

The model makes it intelligible why historical development is directed yet open, why stability appears rational without being necessary, and why alternatives were real even when they were not realized.

At the same time, it separates structural statements from political or normative programs. Statements about order, disintegration, or security need not be read as demands but can be understood as descriptions of dynamic properties of societal systems.

This makes it possible to compare different intellectual traditions on the same analytical level without normatively classifying them or playing them off against one another.

This chapter thereby concludes the formal description of historical movement: societal development appears as a realized path through an open state space whose direction and speed emerge

from its structure, not from assumptions about goals or temporal specifications.

Concluding Question. If societal movement is determined neither by goals nor by time but arises from the structure of possible transitions: How can one recognize when an order is losing its own capacity for movement?

Part II.

The Cognitive Coordination Problem

7. The Historical S: Computational Model and Legibility

In Section 2.5, the concept S was introduced as the set of structural boundary conditions under which social order can emerge at all. This definition was deliberately kept abstract. It was sufficient to develop the formal metamodel, but not sufficient to convey its historical significance.

For understanding societal development, it is necessary to reconstruct S not only formally, but also as an effective structural space. This chapter fulfills precisely this function. It describes neither a historical sequence nor a succession of institutions, but analyzes a structural initial condition and its necessary instability.

At the center stands not the question of *how* societies were historically organized, but under what conditions social order without mediating mechanisms is possible at all. The chapter therefore reconstructs a limiting constellation of complete social legibility and shows why this constellation necessarily collapses with growing group size.

The model used here differs explicitly from moral or normative explanatory approaches. Action is not understood as an expression of timeless individual autonomy, but as movement within a structurally bounded possibility space. Not motivation, but legibility is the central explanatory variable— legibility of a social graph that, with growing societal size, becomes a structural bottleneck.

7.1. The Computational Model

In computer science, every formal system begins with an explicit model of the underlying hardware, for example a Turing machine. Similarly, the description of social order requires a clearly defined computational model. Without such a model, it would remain unclear which operations are possible at all, what costs they incur, and which structural solutions can be stably realized.

In the case of the Turing machine, the internal processes are known; it constitutes a white-box model in which computational operations can be explicitly described and counted. For the human brain, however, the neurobiological knowledge is lacking to model it in a comparable formal manner.

In a black-box model, however, it is possible to quantify which external social events a human can observe, process, and incorporate into their actions. The model thus deliberately abstracts from internal cognitive processes and focuses exclusively on epistemically accessible quantities.

We model a society as a social graph

$$G = (V, E),$$

where each node $v \in V$ represents a human being and each edge $e \in E$ describes a social relationship or interaction between two humans.

The social graph is conceptually always to be understood as complete. Between every pair of individuals there potentially exists a social relation, whether through direct interaction, observation, rumor, dependency, or indirect consequences of actions. Formally, therefore:

$$E = \{\{u, v\} \mid u, v \in V,\ u \neq v\}.$$

Human computational capacity can now be modeled as the ability to epistemically observe and evaluate edges in this graph. A single human can only grasp and actively consider a limited number of k social edges.

The concrete value of k is secondary; what matters solely is that k is finite. Intra-individual differences in k can be neglected in the model. For simplicity, we assume a globally valid parameter k, without restricting the structural generality of the following considerations.

7.2. Paradise: Complete Social Legibility

Let us first consider a society that is so small that every single member can fully observe and evaluate all social relationships.

Formally, this means that the individual observation capacity k is greater than or equal to the number of all edges in the social graph:

$$k \ \geq\ |E| \ =\ \frac{|V|\,(|V|-1)}{2}.$$

For an exemplary value of $k = 150$, this yields a maximum group size of

$$|V| = 17, \qquad \frac{17 \cdot 16}{2} = 136 < 150.$$

In such a group, the entire social graph is epistemically fully accessible to every individual.

In this state, every member can independently observe every social edge: interactions, cooperations, conflicts, or rule violations are visible to all. The behavior of the involved actors can be immediately evaluated, for instance through approval, support, disapproval, or sanction.

Crucially, these evaluations themselves constitute social actions and thereby in turn generate edges in the social graph. Every evaluation is itself observed by the remaining members and evaluated anew. Formally, every action is the object of $|V|-1$ further observations.

This gives rise to a fully feedback-coupled system of mutual observation and evaluation. One could formally model this process as a reinforcement learning system in which evaluation strategies are adjusted through social feedback. Such a formalization is omitted here for reasons of exposition.

What matters solely is that under these conditions a stable convergence of evaluation strategies is to be expected. Deviations are immediately visible, corrections occur without delay, and systematic misevaluations are hardly sustainable in the long run.

This state of complete social legibility constitutes a limiting constellation: a social order in which no additional institutional mediations

are required. All subsequent societal mechanisms can be read as approximations to, abstractions from, or substitute solutions for this state.

7.2.1. Emergent Properties of Complete Social Legibility

The complete epistemic accessibility of the social graph is not merely a formal boundary condition. It generates a series of stable properties that do not arise from norms or institutions but follow directly from the structure itself.

First, action under these conditions is strictly local and autonomous. Every individual acts on the basis of their own observations and evaluations of the entire system. No mediating authority, no delegation, and no external authority is needed to coordinate social behavior. Order emerges directly from individual perception and reaction.

Second, regularity is implicit. Expectations about permissible and impermissible behavior need not be explicitly codified. They arise from the ongoing observation of concrete actions and their social reactions. Rules are not written but lived. Their validity derives from visibility, not from formalization.

Third, there is no separation between social practice and its evaluation. Observation, evaluation, and reaction coincide temporally and structurally. Social order is not something that follows action, but is part of action itself.

Fourth, social information is symmetrically distributed. All relevant events are equally accessible to all members. There are no privileged knowledge positions, no hidden processes, and no systematic information asymmetries.

Fifth, trust is not an independent mechanism but a direct function of observability. Reliability arises not through promises or institutions but through the repeated experience of visible behavior in a fully legible system.

These properties are not normative. They are not ideals but structural consequences of a social graph that is fully observable. They define the reference state against which all subsequent social orders can only operate approximately.

Many of these properties become recognizable only through loss and historical comparison. The enumeration makes no claim to completeness; what matters is their structural function. All subsequent social orders can be assessed according to which of these properties they reproduce, replace, or permanently lose.

Paradise functions not as a normative ideal but as a structural benchmark.

7.3. The Expulsion from Paradise

The paradisiacal state described above denotes neither a geographic location nor a historical myth. It describes exclusively a structural constellation: complete social legibility at finite group size.

This constellation is not stably scalable. With growing group size, the structure of the social graph changes fundamentally.

Since the social graph is always complete, the number of its edges always amounts to:

$$|E| = \frac{|V|(|V|-1)}{2},$$

The number of edges grows quadratically with the number of individuals;

$$|E| \in \mathcal{O}(|V|^2).$$

Already at moderate group sizes, this growth leads to an explosive increase in the social relations to be observed:

- **Village:** $|V| = 1{,}000 \Rightarrow |E| = 499{,}500$
- **City:** $|V| = 100{,}000 \Rightarrow |E| \approx 5 \cdot 10^9$
- **Nation:** $|V| = 10{,}000{,}000 \Rightarrow |E| \approx 5 \cdot 10^{13}$
- **World population (2025):** $|V| \approx 8 \cdot 10^9 \Rightarrow |E| \approx 3.2 \cdot 10^{19}$

The individual observation capacity k, however, remains constant. It does not grow with group size. Thus, beyond a certain point, it necessarily holds that:

$$|E| \gg k.$$

At this moment, complete social legibility becomes structurally impossible. No individual is any longer capable of observing, evaluating, and incorporating the entire social graph into their actions.

The central question is: How should a single human allocate their limited attention when the overwhelming portion of relevant social activity lies beyond their epistemic reach? Which edges should be observed? Which ignored? And on what basis should these decisions be made?

The transition in which group size $|V|$ structurally exceeds the individual observation capacity k marks the expulsion from paradise.

Only here does what we call history begin in the proper sense. The last roughly 6,000 years can be read as a long succession of attempts to cope with this structural overload.

These attempts manifest in the development of coping strategies: social constructions that are supposed to enable the maintenance of agency, coordination, and survival despite limited individual capacities.

At this point, there simultaneously arises a structural division that remains formative for all subsequent historical orders: the separation between lifeworld and system world.

What was previously immediately experienceable, observable, and evaluable is now increasingly replaced by mediating structures. Social order no longer arises solely from direct interaction but from abstract mechanisms, rules, and procedures whose functioning is only partially accessible to the individual actor.

Action continues to take place in the concrete lifeworld, but its coordination increasingly occurs within a system logic separated

from it. This separation is not a cultural artifact but a necessary consequence of the structural illegibility of the entire social graph.

The hardware on which all these mechanisms operate is clearly bounded. It consists of the human brain, human sensory apparatus, the voice, and simple forms of external storage such as gestures, signs, or writing. Even these external media remain bound to human perception: they must be manually produced, transmitted, and read.

Humanity thus attempts to manage, with an extremely limited computational, storage, and communication infrastructure, a social graph that exceeds its cognitive possibilities by orders of magnitude.

All societal mechanisms considered in what follows are responses to this situation. They represent not alternative paradises but pragmatic strategies for living with structural opacity.

7.4. Perspectives of Evaluation

With the exceeding of the cognitive observation threshold, it is not yet determined *from which perspective* social relations are evaluated. The model permits fundamentally different evaluation logics.

One obvious perspective is the collective one. It understands humanity as a swarm that seeks to secure its collective survival. Social edges are evaluated according to the extent to which an observed behavior contributes to the stability, reproductive capacity, or

resilience of the group. Reward and sanction are relative to the common good.

A second, equally obvious perspective is the individual one. Here, each individual evaluates social edges according to what personal benefit or harm a behavior causes. Reward and sanction follow self-interest, status, security, or resource access.

The model used here is agnostic with respect to this distinction. It presupposes neither altruistic nor egoistic motivation and privileges neither of the two perspectives.

Instead, the mechanisms described in what follows are largely *perspective-stable*. They function both when actors evaluate primarily individually and when they act with a collective orientation.

Mechanisms that would be stable only under a specific perspective would not be historically viable. The stability of the solutions described rests not on morality but on their structural capacity to reduce social complexity under limited cognitive capacity.

Concluding Question. But with what concrete mechanisms has humanity attempted to replace complete social legibility?

8. Centralization in the Historical S

The following sections address the first and oldest class of historical coordination mechanisms: centralization and division-of-labor-based administration. They describe how societies have responded to the structural illegibility of large social graphs by developing hierarchical delegation structures.

This selection claims neither completeness nor an exhaustive discussion of all advantages and disadvantages. The structures considered here do not form a closed catalog, but rather a functionally coherent excerpt.

For the context of this book, it is not decisive which specific mechanisms exist or how they are designed in detail. What is decisive is that such mechanisms exist at all and that each possesses very specific structural properties. These properties are not historical accidents but follow necessarily from their mode of operation under the boundary conditions of S.

Many of the effects described here have already been analyzed by various authors and evaluated historically or normatively. These analyses, however, were mostly conducted within other theoretical frameworks and without an explicit model of the underlying structural constraints.

For orientation within the history of ideas, the names of key authors are therefore mentioned at appropriate points. A detailed

discussion of specific texts or works is, however, not the aim of this chapter.

The task of the model is to reveal the structural necessity of these mechanisms. It does not explain individual properties, but rather why such mechanisms arise and remain stable at all under given conditions of S.

8.1. Queen

Once the size of a tribe exceeds a threshold at which the number of social edges surpasses individual observation capacity, that is

$$|E| > k$$

complete social legibility begins to gradually disintegrate. As group size continues to grow, soon

$$|E| \gg k$$

and the previous form of direct mutual observation becomes structurally impossible.

The tribe responds by establishing a single central authority: the queen.

The queen exclusively assumes the role of a central communication and coordination authority. The crucial point is not that all other

social edges disappear, but that for every tribe member a particular edge becomes *mandatory*: the relationship to the queen.

Every member must always take this edge into account and prioritize it highly over competing relations, because task assignment, reporting obligations, and resource flows run through precisely this connection.

Structurally, this guarantees the formation of a star-shaped subgraph around the queen: the queen sits at the center, and all other nodes are connected to her by at least one direct edge. Additional edges between non-center nodes may continue to exist but remain functionally secondary.

This star is a strictly smaller subgraph of G, yet it functionally replaces the full observation that is no longer feasible. Social information is no longer mediated horizontally but vertically.

The daily routine follows a simple schema. Each tribe member contacts the queen at the beginning of the day and receives a task. At the end of the day, the member returns to the queen and reports on activities and results.

At the same time, the queen functions as a central collection and distribution point. The goods produced during the day are delivered to her. From the accumulated total, she allocates to each member a portion she deems appropriate.

Through this construction, the tribe becomes capable of collective action at the aggregate level once again. Coordination, task as-

signment, and resource distribution are mediated through a single node.

The scalability of this mechanism is, however, structurally limited. The queen is herself a human actor with finite observation capacity. Once the number of tribe members exceeds the queen's cognitive capacity, that is

$$|V| > k$$

this mechanism too becomes unstable.

8.1.1. Performance and Limits of the Queen Structure

The queen structure offers a **radical complexity reduction** of social interaction by projecting the relevant subgraph for each tribe member onto a single, highly prioritized edge. Instead of observing a quadratically growing social graph, orientation toward a central authority suffices. This reduction is brutal but effective: it makes collective action possible again under conditions of extreme cognitive scarcity.

The queen structure introduces **centralized will formation**. Decisions about task allocation, resource deployment, and collective goals are no longer made through local, autonomous assessments but delegated to a single authority. The tribe thereby undergoes the transition from a self-organized swarm to a heteronomous order. Agency no longer arises through immediate coordination but through subordination to a centrally formulated will.

The queen structure makes the **common good explicitly addressable**. Since information, tasks, and resources converge centrally, collective projects can be organized that transcend local perspectives. The mechanism thus allows, for the first time, collective interests to be formulated as such and enforced against individual preferences.

With central coordination, **power both internally and externally** emerges simultaneously. Internally, the queen possesses the ability to enforce directives and sanction deviations. Externally, the tribe can act as a unified entity, for example in the form of organized violence or collective deterrence.

With the central collection and distribution point, an implicit **form of taxation** is introduced. The queen collects the yields of individual labor and decides on their redistribution. Resources can thereby be redirected, pooled, or prioritized according to superordinate criteria.

The queen structure generates a **structural principal–agent problem**. The central authority makes decisions on behalf of the entire tribe but possesses its own interests, preferences, and information gaps. Since observation and control are asymmetrically distributed, deviations between the delegated mandate and actual conduct can only be detected or corrected to a limited extent. The problem is not a moral failure but a necessary consequence of central representation under limited observability.

At the same time, **ruling knowledge** emerges. Since all reports, observations, and resource inflows converge at the central authority,

the queen possesses an informational advantage over all other tribe members. This knowledge is not merely aggregated but structurally exclusive: no single actor has access to a comparable overview. Rule thus stabilizes itself not only through violence or coercion but through asymmetric information.

The queen structure depends on **explicit communication**. Work, observations, and deviations must be reported verbally or otherwise transmitted symbolically in order to be accessible to the central authority. What is not spoken, formulated, or documented does not exist for coordination purposes. Implicit knowledge, situational nuances, or non-articulable activities are thereby systematically lost.

The queen structure is **highly fragile**. Since coordination, knowledge aggregation, and decision-making authority are concentrated in a single node, there is a pronounced single point of failure. The failure, elimination, or corruption of the central authority leads immediately to the collapse of order.

The queen structure possesses a **hard scaling limit**. Since the central authority also has only finite observation and processing capacities, its load grows linearly with the number of tribe members. Beyond a certain point, the volume of incoming information exceeds the queen's cognitive capacity. The mechanism then loses its coordinating effect and itself becomes a source of disturbances.

8.2. Bureaucracy & Hierarchy

As the tribe continues to grow such that

$$|V| > k$$

the previously introduced queen mechanism reaches its structural limit. The central authority is no longer able to process all relevant communication, coordination, and reporting edges by herself.

The first response consists in introducing an assistant who takes over the direct supervision of a portion of the tribe members.

With further growth of the tribe, additional assistants are introduced. Each manages a disjoint subset of tribe members and functions as their primary point of contact. The queen ultimately concentrates exclusively on coordinating her assistants. Structurally, a two-tiered order emerges.

In this model as well, the cognitive capacity of each actor remains finite. Managing other persons constitutes a particularly demanding form of social observation. We denote the maximum number of directly manageable subordinates by the parameter b. Empirically, this value typically lies in the range

$$4 < b < 12$$

.

The queen can thus coordinate at most b assistants directly. Analogously, each assistant can manage at most b subordinate actors.

As the tribe continues to grow such that

$$|V| > b^2$$

, the assistants too are overwhelmed. The solution consists in introducing a further management level. Assistants in turn receive their own assistants. A tiered, tree-like structure emerges.

In a three-tiered order, the queen manages up to b assistants at the first level, who each manage up to b assistants at the second level, who in turn supervise up to b tribe members.

In this way, a tribe can coordinate up to

$$|V| = b^3$$

members, where the number of management-related actors is

$$b + b^2$$

.

This principle can be continued indefinitely. With each additional level, the maximum manageable group size grows multiplicatively, while individual observation and management capacity remains constant.

Structurally, this delegation logic produces a tree with three types of nodes:

- a root, representing the top-level coordination authority,

- internal nodes, performing management and intermediation tasks,
- leaf nodes, representing the directly managed tribe members.

The root and the internal nodes have a fanout between 2 and b. The tree is not necessarily strictly balanced, but should not be heavily unbalanced in order to fulfill its purpose.

The resulting structure thus corresponds to a data structure well known in computer science: the B-tree. It is characterized by being relatively shallow, with a depth of

$$\mathcal{O}(\log_b |V|),$$

so that even very large structures remain surveyable from above. At the same time, the vertical communication paths between root and leaf nodes are kept logarithmically short.

The most costly operation in such a structure is its reorganization, in particular rebalancing after structural changes.

Administration scales linearly but more slowly than the operative base: $I \approx \frac{1}{b} L$. For every b managed tribe members, one additional administrative assistant is required.

The mechanism described can be expressed in the terminology of administrative science.

First, a division-of-labor-based organization of coordination and administrative tasks was introduced. This decomposition of governance we call *bureaucracy*.

Second, this division of labor necessarily gave rise to a pyramidal tree structure in which responsibility, reporting obligations, and decision-making authority are organized directionally. This structure we call *hierarchy*.

The two concepts are not identical but structurally coupled. Whoever introduces division-of-labor-based administration inevitably invents hierarchy along with it.

It should be emphasized that the structure presented here models an isolated hierarchy. In reality, however, such trees rarely exist autonomously.

In particular, the apex of an organization only appears to be a root node. In many cases, it is itself embedded in a superordinate structure: companies are subject to capital providers, banks are subject to central banks, state apparatuses are subject to supranational institutions or geopolitical dependencies.

Structurally, this gives rise to cascading hierarchies—trees whose roots are in turn embedded in other trees. The logic described here is preserved but nested across multiple levels.

The apparent root is therefore frequently merely an internal node in a more comprehensive power and coordination structure.

Institutional Manifestations The structure described here is not an abstract thought experiment. It describes real large-scale organizations.

A state, a national army, a socialist planning regime, or a multinational Fortune 500 corporation differ normatively, ideologically, and legally, but not in their fundamental coordination structure.

In all cases, a hierarchical-bureaucratic tree structure is present, whose size typically lies in comparable orders of magnitude. The American military, a large socialist state, or a global corporation operate structurally as B-trees of similar depth and similar fanout.

The differences concern purpose, legitimation, and form of ownership. The underlying computational structure remains identical.

Ronald Coase showed in *The Nature of the Firm* that firms arise because market transactions incur costs. Search, negotiation, monitoring, and contract enforcement require information and generate friction.

In the terminology used here, these transaction costs can be interpreted as costs of ephemeral edges. Every market transaction creates a new, temporary edge in the social graph that must be epistemically observed, evaluated, and secured.

The firm replaces these ephemeral edges with stable, institutionalized relationships. Edges are fixed, roles are defined, and communication follows prescribed paths.

This observation applies not only to firms but equally to state bureaucracies. Both reduce the costs of social coordination by turning open markets into closed subtrees.

8.3. The State as Extended Bureaucracy

Structurally, the state does not differ fundamentally from the firm. The state, however, possesses additional functions that distinguish it from all other hierarchical organizations. These additional functions concern not the internal tree structure but the scope and depth of its embedding in the social graph G.

First, the state holds a **monopoly on violence**. It is the only hierarchical structure that may legitimately deploy physical coercive means both internally and externally. Internally, this means the enforcement of rules through police, courts, and penal systems. Externally, it means the capacity for warfare. This capacity for violence stabilizes the tree structure and secures its enforceability against competing trees.

Second, the state organizes **addressability and identity**. It administers persistent identities of persons (civil registration) and things (land registries, vehicle registries, corporate registries). These identities are a necessary prerequisite for unambiguously integrating nodes into hierarchical structures. Without stable identity assignment, tax collection, property allocation, contract formation, and judicial enforcement would be impossible. The state thus functions as the primary addressing authority for all subordinate organizations.

Third, the state provides **reputation and dispute resolution mechanisms**. Courts, administrative procedures, and public registries enable the formal assessment of behavior and the settlement

of conflicts. These functions structurally correspond to the reputation management of modern platforms. They are necessary to stabilize transactions between anonymous or only loosely connected actors.

Fourth, the state provides **monetary infrastructure**. Currency, central banking, payment enforcement, and the legal framework for property constitute the prerequisites for the functioning of the monetary mechanism. Without state enforcement, money would lose its general acceptance. The state is thus not merely a user but a constitutive condition of the monetary system.

Fifth, the state provides **public infrastructure** for all subordinate trees: security, education, transportation networks, legal systems, and regulatory frameworks. This infrastructure lowers transaction costs and makes the existence of large firms possible in the first place.

The state is therefore not merely a particularly large B-tree. It is the prototypical platform structure of history. It provides the fundamental protocols on which other hierarchical organizations operate.

8.3.1. Advantages and Disadvantages

The bureaucratic-hierarchical structure is the first known mechanism that reliably scales social order beyond the limits of individual

observation capacity. Through delegation and tree structure, coordination becomes possible even when the underlying social graph has become epistemically illegible.

Bureaucracy enables **division-of-labor-based specialization**: the decomposition of complex tasks into specialized roles. Productivity arises not through comprehensive knowledge of individual actors but through coordinated partial competencies under central control.

Bureaucratic structures decouple organization from individual actors. Knowledge, processes, and responsibilities are institutionalized and remain stably reproducible across generations.

The structure permits the formulation and enforcement of a unified collective will, even given heterogeneous interests at the operative level.

Information is filtered and aggregated along the hierarchy. At the top, a compressed situational picture emerges that permits decisions without presupposing complete knowledge of the social graph.

The structure is well suited for the operationalization of coercion: taxes, recruitment, punishment, and warfare can be efficiently organized.

Formalized rules, responsibilities, and procedures make behavior predictable. Coordination is based not on personal trust but on institutionalized rule compliance.

In stable, slowly changing environments, bureaucracy is highly efficient. It is particularly suited for repetitive processes and long-term constant tasks.

The structure possesses **limited scalability**. Centralized and hierarchical orders can only grow by introducing additional management levels. Since the fanout of each node is cognitively bounded, scaling is achieved not through efficiency but through structural multiplication. With each additional level, communication paths and reaction times lengthen.

The structure is characterized by **extreme inflexibility**. Hierarchical orders respond to changed environmental conditions not through local adaptation but through reorganization of entire subtrees. Responsibilities, reporting lines, and decision-making authorities are hard-wired and can only be altered at great cost.

As a consequence, the structure performs **extremely poorly in the sense of Ashby's Law of Requisite Variety**. The variety of the environment to which the organization must respond increases with the size and interconnectedness of the system. The internal decision-making and control variety, however, remains severely constrained by the limited cognitive capacity of the hierarchy's nodes. The organization therefore cannot provide the requisite variety to adequately regulate complex and dynamic environments.

The structure suffers across all levels from a pronounced **principal–agent problem**. Goals, information states, and incentives are not identically distributed along the hierarchy. Decisions are made at higher levels, while execution and situational knowledge reside

at lower levels. This separation produces systematic distortions: reports are filtered, problems are attenuated, and successes are overemphasized.

Additionally, a structural **moral hazard problem** arises. Decisions and their consequences are decoupled along the hierarchy. Those who decide frequently do not bear the negative consequences themselves; those who bear the consequences did not make the decision. Responsibility is thereby fragmented to such an extent that it is practically no longer unambiguously attributable.

Hierarchical bureaucracy inevitably generates a pronounced **inside–outside perspective**. As humanity grows, multiple such pyramidally organized structures exist in parallel, and they no longer primarily conceive of themselves as parts of a shared social graph but as demarcated units. Internal communication is privileged over external communication; loyalty is demanded inward. The social graph thereby disintegrates epistemically into competing subgraphs.

The hierarchical-bureaucratic structure inherits the **fragility** of the queen structure. Although tasks are formally distributed, decision-making and control competencies remain strongly concentrated at the top. In particular, the apex of the hierarchy constitutes a structural single point of failure, vulnerable to extortion, corruption, political influence, or targeted elimination.

The hierarchical-bureaucratic structure necessarily leads to **structurally induced discrimination**. Advancement proceeds through a sequence of discrete promotions, at each of which small biases,

implicit preferences, or minimal evaluation differences take effect. These effects accumulate across levels: a slight bias at each stage suffices to produce a strongly homogeneous group at the apex of the pyramid. Discrimination here is not primarily a moral failure of individual actors but an emergent result of a multi-stage selection structure.

The hierarchical-bureaucratic structure inevitably produces an **exponential income distribution**. The reason lies not in individual greed but in the recursive aggregation logic of the structure itself. Value creation occurs predominantly at the lower levels but is passed upward step by step along the management chain. Since each level retains a fixed share of the subordinate value creation, the available income grows multiplicatively with each hierarchical tier.

A simple example illustrates the effect. Let the fanout be $b = 8$ and the extraction rate $f = 50\%$. Each leaf node generates one unit of value creation, retains 0,5 of it, and passes 0,5 upward. A manager at the next level thus receives $8 \times 0{,}5 = 4$ units, retains 2, and passes 2 further up. This yields a factor of 4 per hierarchical level.

This distributional logic additionally generates a **structural gender imbalance**. Since positions at higher levels offer multiples of the incomes at lower levels, it is rational for households to concentrate on a single career. In practice, this role is assigned to whichever partner exhibits fewer biographical interruptions.

The bureaucratic-hierarchical structure leads to a **selective for-**

mation of virtues. Since advancement occurs exclusively along vertical management paths, those behaviors are systematically rewarded that are career-promoting within this structure. What matters is not primarily professional excellence but the ability to signal loyalty upward and exercise control downward.

Specifically, the structure favors traits such as adaptability toward superiors, strategic conformity, information withholding, and the targeted delegation of responsibility downward. At the same time, cooperative, cross-cutting, or system-critical behaviors are negatively selected.

The structure thus shapes in the long run not only organizations but also personality profiles. What appears as individual virtue is in reality the result of a selection process generated by the hierarchical order itself.

The bureaucratic-hierarchical structure inevitably produces an **inside–outside separation**: social space is segmented into organization-internal and external domains. Moral evaluation no longer orients itself by universal standards but by the instrumental rationality of one's own hierarchy. Actions are deemed legitimate insofar as they serve the interests of one's own structure, even if they appear harmful externally.

The **long-term degeneration** of bureaucratic-hierarchical systems has been extensively described in organizational sociology.

A central observation is **Parkinson's Law** (C. Northcote Parkinson): administrative activity tends to expand independently of

actual workload. Organizations grow inward because additional levels, roles, and procedures are structurally rewarded.

Closely related is **goal displacement** (*goal displacement*, Robert K. Merton). Formal procedures, metrics, and rules that were originally means to an end become ends in themselves. Success is measured by rule compliance, not by the solution of the original problem.

Finally, Robert Michels describes with the **Iron Law of Oligarchy** that complex organizations inevitably tend toward the concentration of power at the top. Informational advantages, decision-making monopolies, and self-recruitment of the leadership level result in the formation of a permanent ruling stratum.

These forms of degeneration are neither historical accidents nor moral failings of individual actors. They arise necessarily from the structure of division-of-labor-based bureaucracy under limited individual computational and observation capacity.

Concluding Question. Centralization solves the problem of limited social legibility through delegation— through hierarchy, bureaucracy, and command paths. This form of coordination is powerful but generates structural costs: information losses, principal-agent problems, and inflexibility.

What mechanisms enable coordination where explicit hierarchy is too costly, too rigid, or simply absent— where distributed value creation must occur without a central command path?

9. Money and Property in the Historical S

Where hierarchical bureaucracy reaches structural limits — with growing complexity, spatial distance, and the necessity of decentralized coordination — two complementary mechanisms emerge: money and property.

Both operate without a central command path. Money coordinates through price signals and abstracts value creation into a universal token. Property stabilizes the use of scarce resources through the internalization of incentives. Together with bureaucracy, they form the structural backbone of societal coordination in the historical S.

9.1. Money

Money supplements bureaucratic hierarchy where explicit coordination reaches structural limits. With growing societal differentiation, the complexity of value creation permanently exceeds the limits of central comprehensibility. Money accepts this epistemic illegibility and radically reduces the demands on each individual actor: everyone can act without needing to know the structure of value creation, the identity of participants, or the long-term effects of their own actions.

The mechanics are simple. Two actors A and B negotiate a price p. A transfers p to B and receives the good g in return. The price is the only relevant information. The origin of the good, the structure of the value chain, the identity of further participants — all of this remains irrelevant to the mechanism. The epistemic horizon of each actor extends exactly one edge in the social graph.

Money is not a consumable good but a transferable access token. It signals that the holder has previously made a contribution and legitimizes future consumption — without recording the type, location, or timing of that contribution. The provision and consumption of services are thereby decoupled across time, space, and social relationships. As a cybernetic system, money regulates not processes or rules but the epistemic preconditions of societal decision-making: not *what* is done, but *by what criteria* decisions are made.

As an information network, money possesses an extremely low variety: a one-dimensional, event-based signal. Heterogeneous matters — origin, conditions, risks, long-term effects — are compressed into a single natural number. This reduction is a precondition of scalability but limits the depth of possible coordination. From the coupling of many epistemically constrained decisions, a decentralized, emergent order arises — a swarm behavior without central control that nevertheless produces large-scale structure.

9.1.1. Temporal Finalization of Valuation

The money mechanism evaluates actions, goods, and services exclusively at a single point in time: the moment of the transaction.

Upon completion of payment, the valuation is considered final. Later insights, changed perspectives, or newly emerging effects can no longer be integrated into the original valuation.

This temporal finalization is not a conceptual choice but a structural necessity. Under conditions of limited communication and absent global addressability, a continuous revaluation of past transactions would be organizationally unmanageable. Money closes valuation in order to make coordination possible at all.

Human valuation, however, is inherently dynamic. Actions are retrospectively reclassified, contextualized, and corrected as soon as additional information becomes available. This form of processual valuation cannot be represented within the money mechanism.

The consequence is a systematic decoupling of action and subsequent effect. Negative effects that manifest only with a time delay lie outside the valuation window and remain invisible to the mechanism. Money possesses no memory and no capacity for retroactive correction.

The mechanism thus privileges short-term, punctually assessable effects over long-term, processual impacts. This temporal limitation constitutes a fundamental structural boundary of money-based coordination.

9.1.2. Local View and Structural Blindness

The money mechanism operates exclusively at the level of direct transactions between two actors. The relevant epistemic horizon

is limited to immediate contacts. Each actor perceives only their own transaction partner and the agreed-upon price.

More distant parts of the value chain remain invisible to the mechanism. Neither upstream contributions nor downstream effects of an action are captured or communicated. Money possesses no representation of the social or economic graph beyond individual edges.

This local view is a precondition for the scalability of the mechanism. It enables coordination even when global oversight is structurally impossible. At the same time, however, it produces a systematic blindness to effects that occur outside the immediate transaction.

Affected actors who are not directly involved in a transaction cannot introduce their interests into the decision-making process. Damages, burdens, or risks that affect third parties do not appear as relevant information. The mechanism knows only bilateral exchange relationships.

The local limitation of view means that effects across space, social distance, or institutional boundaries cannot be addressed. External effects arise not from misconduct by individual actors but as a necessary consequence of a coordination form that processes exclusively local information.

9.1.3. One-Dimensional Aggregation and Information Loss

The money mechanism aggregates heterogeneous information into a single scalar value: the price. Qualitatively different aspects of a good or an action are consolidated into a single real number and thereby made comparable.

This aggregation concerns information of very different kinds, such as ecological consequences, social conditions, risks, alternatives, or long-term effects. The mechanism abstracts completely from their internal structure and projects them onto a one-dimensional scale.

The resulting reduction is radical. It permits rapid processing, comparability, and connectivity, but entails a structural loss of information. Multidimensional matters are reduced to a form that can no longer represent their internal diversity.

A second structural limitation is added: The price is communicated only at the moment of a transaction or an attempted transaction. The information rate of the system is therefore extremely low. Measured in bits per second, only sporadic individual numerical values are exchanged between two actors.

The network of monetary transactions is thus not only one-dimensional but also low-frequency. Information circulates punctually, not continuously.

According to Ashby's Law of Requisite Variety, a system can only regulate those environmental states whose variety it can represent

internally. The combination of one-dimensional representation and low information rate considerably limits the effective variety of the money mechanism. The complex structure of societal value creation permanently exceeds this representational and transmission capacity.

Theoretical models of efficient markets, as described in particular by Hayek, implicitly presuppose that price signals reflect all relevant information in the network with sufficient speed and precision. Under these conditions, the system would permanently self-equilibrate.

Empirically, however, it is evident that systemic misallocations, bubble formations, and crises occur repeatedly. In such situations, the implicit coordination through price signals fails. The circulation of money must then be restarted through external interventions, as Keynes proposed.

Hayek's model thus describes a theoretical limiting case of optimal information processing. The historically realized monetary system, however, operates under significantly more restrictive information conditions. Its structural limits are not moral defects but direct consequences of its reduced information architecture.

A particularly illustrative example of this structural limitation is provided by an economic crisis. In a crisis, remarkably little often changes about the real foundations of production: The planet is the same, the land is the same, the population with its skills is still present, machines, infrastructure, and knowledge continue to exist. What stalls, however, is the circulation of money.

The so-called economic crisis is thus less a collapse of real productive capacity than a failure of the money-based information and coordination network. When the token no longer circulates, exchange relationships break down even though the underlying capacity for value creation remains unchanged. The crisis appears economic but is structurally a communication problem. And this problem is inherent to the money mechanism.

9.1.4. Absence of Collective Will Formation and Structural Non-Addressability of the Common Good

The money mechanism possesses no locus at which a collective will could be formulated or articulated. Decisions emerge in a decentralized manner from local transactions and are coordinated exclusively through implicit feedback loops.

Prices aggregate individual willingness to pay, but not goals, preferences, or normative deliberations. The mechanism can therefore set no priorities, weigh no competing values against one another, and pursue no explicit purposes. Coordination occurs without goal formation.

The common good, however, presupposes the ability to formulate collective interests, to discuss them, and to enforce them against individual incentives. This form of explicit will formation is structurally not provided for in the money mechanism. Shared goals can at most emerge as unintended by-products, but never as intended outcomes.

The money mechanism thus produces order without purpose. It coordinates actions efficiently without being able to distinguish between socially desirable and undesirable outcomes. The non-addressability of the common good is not a failure of the mechanism but a necessary consequence of its decentralized and implicit structure.

9.1.5. Failure in the Case of Concentration

The money mechanism implicitly presupposes that the steering medium — money itself — circulates in a sufficiently distributed manner. Only when many actors possess purchasing power can decentralized coordination take place. Extreme concentration of money structurally undermines this precondition.

Two mechanisms favor such concentration. First, money generates political influence. Capital can be deployed to influence rules, market access, or institutional frameworks, thereby stabilizing or expanding existing wealth positions. A positive feedback loop emerges between economic and political power.

Second, capital subject to interest follows an exponential dynamic. Under compound interest, wealth grows according to

$$K(t) = K_0(1 + r)^t,$$

where small initial differences lead to structurally dominant positions over longer time horizons. After certain thresholds are

exceeded, catching up becomes practically impossible for subsequent actors regardless of individual capability. This dynamic operates at both the individual level and intergenerationally, as well as between economies.

When strong concentration occurs, two structural problems arise.

First, money loses its **steering function**. When only a few actors possess relevant purchasing power, the mechanism can no longer function as a distributed coordination system. A large proportion of nodes in the social graph no longer possess sufficient tokens to effectively articulate preferences. The situation resembles a token-ring network in which a single node permanently holds the steering medium. Coordination then becomes not distributed but unilateral.

Second, there is a **loss of distributed knowledge processing**. The market mechanism aggregates only that information which manifests in purchasing-power-backed demand. When purchasing power is highly concentrated, prices primarily reflect the preferences of a few actors. The knowledge distributed throughout the rest of the system no longer enters into price formation. The decentralized knowledge aggregation that gives the market mechanism its effectiveness is structurally reduced. A form of private knowledge presumption emerges that is functionally similar to the central concentration of information in bureaucratic systems.

Failure in the case of concentration is thus not a moral problem but a structural one. A coordination mechanism whose steering

medium permanently concentrates loses the very properties that originally made it effective.

9.2. Communal Use and Property

A good can be used and managed communally by a community. Typically, this involves a limited resource, such as a meadow or a field, whose yield depends on the type and intensity of its use.

Two quantities are decisive for the stability of such communal use. First, it must be possible to observe what contribution individual members make to the preservation and improvement of the good, for instance through maintenance, cultivation, or investment. Second, it must be observable to what extent individual members extract yields from the good.

In very small communities, this observation is possible. Contributions and extractions are visible, deviations are noticed, and social sanctions can take effect. Under these conditions, a communally used good can be managed stably without formal rules or explicit accounting.

As the community grows, however, the number of relevant social edges exceeds individual observational capacity. For the individual actor, it becomes impossible to oversee how much others invest or extract. No instance exists that could reliably capture both quantities.

In this situation, incentives shift systematically. Investments in the good generate positive effects for all but are no longer reliably recognized or rewarded at the individual level. Extractions, on the other hand, remain largely invisible and can no longer be effectively sanctioned.

The consequence is an asymmetric incentive structure: a positive incentive for extraction emerges while no effective incentive for investment remains. Individually rational behavior leads to declining contributions and increasing extractions. The communally used good is overexploited and gradually loses its productivity.

This dynamic is not a moral failure of individual actors but a structural consequence of limited observational and communicative capacity. Communal use does not collapse despite rational behavior but precisely because of its local rationality.

9.3. Property as a Substitute for Communication

The described instability of communal use can be remedied by a simple structural intervention: The good is partitioned into disjoint parts, and each part is made exclusively available to a single actor.

With this assignment, property emerges. An actor receives the sole right of use over a clearly delineated part of the good. Other

members of the community are excluded from using this part. The owner thus holds a monopoly on investment and extraction.

Through this exclusivity, the need for social observation is eliminated. The owner need neither track the contributions of others nor monitor their extractions. Both previously critical quantities — investment and use — converge in a single person.

The incentive structure changes fundamentally. Investments benefit exclusively the owner; likewise, the long-term consequences of extractions fall exclusively on the owner. Positive and negative effects are no longer distributed but internalized.

Property thus replaces communication with structure. Instead of communal deliberation, exclusive responsibility is assigned. Coordination effort is minimized by not resolving potential conflicts but excluding them.

The good can be managed stably under these conditions. Not because the common good is addressed, but because individual incentives and the long-term preservation of the good are structurally aligned.

9.4. Property as a Game-Theoretic Algorithm

Property is not a moral or legal concept in the narrow sense but a game-theoretic mechanism for stabilizing use and investment under conditions of limited observability.

The mechanism transforms a collective interaction problem into a set of independent single-person problems. Through the exclusive assignment of a good, decision, responsibility, and consequence converge in a single person. Strategic interdependencies between actors are structurally reduced.

From a game-theoretic perspective, property internalizes external effects. Investments increase future utility exclusively for the owner, while overuse harms exclusively the owner. Dominant strategies thereby shift from short-term extraction toward long-term preservation and improvement of the good.

The algorithm requires neither communication nor coordination between actors. It presupposes no agreement on fair distribution, no explicit goal formation, and no enforcement of communal norms. Stability arises solely from the coupling of individual incentives to long-term consequences.

Property thus does not address the common good in the sense of collective goal-setting. It does, however, produce socially beneficial effects by securing the productivity of individual goods and preventing their deterioration. Order arises not through collective decision but through the structural individualization of responsibility.

9.5. Advantages and Unintended Effects of the Property Mechanism

The advantages of the property mechanism follow directly from its design objectives. Property is explicitly constructed to enable the stabilization of scarce goods under conditions of limited observational and communicative capacity. Exclusivity, internalization of effects, and long-term investment incentives are not side effects but intended results of the algorithm.

The problematic effects of property, by contrast, are not part of this objective. They arise not from misapplication or moral failure of individual actors but from the long-term application of a highly specialized mechanism in complex societal contexts. In contrast to the advantages, the disadvantages of property are not explicitly designed, are historically often recognizable only with delay, and are structurally complex. They concern not the functionality of the mechanism itself but its interaction with growth, time, inequality, and collective interests.

The following sections are therefore devoted to the systematic analysis of these unintended effects. The goal is not a normative evaluation of property but an understanding of its structural limits under the conditions of S.

9.5.1. Indirect Common Good Effects

The property mechanism primarily addresses individual incentives. It optimizes the use of individual goods by binding decision-making power, responsibility, and returns to a single person. Collective goals or societal priorities are not provided for within the mechanism itself.

The common good therefore arises under property not directly but at most indirectly. More productive goods can generate societal benefit in aggregate without this benefit being explicitly pursued or steered. The common good is a possible by-product, not a target parameter of the algorithm.

The common good, however, is not the union of individual interests. It presupposes the ability to weigh competing individual interests against one another and to set them aside situationally. This form of collective prioritization cannot be structurally achieved through property.

The property mechanism thus generates efficiency at the level of individual resources but possesses no direct channel for addressing the common good.

9.5.2. Missing Coupling of Decision-Making Power and Competence

The property mechanism determines who may decide over a resource but makes no statement about whether this actor is suited

for managing the resource. Decision-making power is coupled to ownership, not to knowledge, ability, or foresight.

Property can be acquired through purchase, inheritance, or historical allocation, independently of the owner's competence. The mechanism contains no selection or correction mechanism that would reliably prevent poor management.

Unproductive or harmful use of a resource is therefore structurally possible and can remain stable over long periods. Negative consequences affect not exclusively the owner but frequently also third parties or society as a whole.

Property ensures that someone is responsible but does not guarantee that this responsibility is exercised competently.

9.5.3. Temporal Path Dependency and Inheritance

Property is designed for permanence. Once assigned, it persists over long periods and is frequently passed on across generations. Earlier allocations thus have lasting effects into the future.

This temporal persistence generates path dependency. Random, historical, or contingent initial distributions are not corrected but structurally stabilized. The mechanism contains no internal capacity for revision or reassessment of prior allocations.

Through inheritance, property becomes increasingly decoupled from the outcomes of individual decisions. Decision-making power

and resource ownership are passed on without consideration of current use, need, or competence.

Property thus functions as a store of past distributions. Time does not act as an equalizer but as an amplifier, solidifying existing differences.

9.5.4. Accumulation and Concentration over Time

Property possesses a recursive dynamic: existing property facilitates the acquisition of further property. Resources, security, and access to capital increase the ability to acquire additional goods and diversify risks.

This dynamic operates cumulatively. Over time, it leads to an increasing concentration of property among few actors. The mechanism contains no inherent dampening or equalizing effect that would limit this development.

The resulting concentration is not the result of individual misjudgments but a systemic consequence of the logic of property itself. Property reproduces itself, independently of use efficiency or societal need.

With growing concentration, the character of the mechanism shifts. Property no longer serves primarily to stabilize individual resources but becomes an instrument of control over further resources.

9.5.5. Exponential Wealth Dynamics and Structural Impossibility of Catching Up

The temporal dynamics of property are not linear but exponential. Existing wealth generates further wealth, for instance through returns, interest, or comparable amplification mechanisms. Growth is proportional to the existing stock.

Exponential processes proceed nearly flat over long time horizons. Differences between actors initially appear small and socially inconspicuous. This creates the impression of long-term stability and sustainability of the mechanism.

Beyond a certain point, however, the dynamic accelerates steeply. Wealth differences then grow not slowly but at an accelerating rate. Actors without significant initial wealth can no longer structurally close this gap, regardless of individual performance or frugality.

This impossibility of catching up applies at both the individual and the collective level. Individuals as well as entire societies or states can no longer compensate existing wealth differentials through growth or productivity gains.

Inequality thus shifts from a distributional problem to a dynamic impossibility. Time does not equalize but acts as an amplifier of existing asymmetries.

9.5.6. Absent Common Good Returns from Productivity Gains

The property mechanism generates productivity gains at the level of individual resources. These gains, however, are not tied to redistribution or societal use. The mechanism contains no rule requiring that additional yields flow to the common good.

Instead, productivity gains are frequently reabsorbed. Surpluses increase the individual consumption scope of owners or flow into further accumulation. Rebound effects cause efficiency gains not to result in proportional improvements in societal well-being.

With growing resource ownership, additional yields are subject to diminishing marginal utility. Further consumption possibilities yield only marginal additional benefit, while at the same time basic needs of other actors remain unmet.

The mechanism thus optimizes the productivity of goods, not the distribution of their yields. The hoped-for medium-term effects for the common good materialize only partially or fail to materialize at all.

9.5.7. Categorical Misapplication of a Powerful Mechanism

The property mechanism is a highly effective instrument for stabilizing the use of scarce, rivalrous resources. Its effectiveness has over time led to the development of an extensive institutional

framework, particularly within the legal system. Titles, contracts, courts, and enforcement mechanisms endow property with high robustness and enforcement power.

This institutional strength, however, favors a categorical fallacy: property is applied to objects for which the preconditions of the mechanism are not met. The algorithm is generalized even though its validity conditions are violated.

Intellectual Property. Knowledge, ideas, cultural works, or software are non-rivalrous goods. Their use by one actor does not exclude others and creates no extraction problem. Continuous investments in the preservation of the good are also not required. The central purpose of the property mechanism is absent.

The application of exclusivity in this context creates artificial scarcity without solving a real coordination problem. Property is employed here not to stabilize use but to enforce exclusion. The mechanism operates in a maladapted manner.

Slavery. The application of the property concept to human beings represents a categorical borderline case. Humans are not goods, not resources, and not objects of optimization. Their treatment as property negates autonomy, dignity, and independent agency.

Historically, this deployment of the property mechanism was comprehensively secured through titles, contracts, courts, and institutions. This does not point to a functional failure of the mechanism. On the contrary: property fulfilled its coordinating function in this

context as well, by unambiguously assigning control, investment, and returns and keeping the system stable over long periods.

The rupture lies exclusively at the moral level. A functionally effective mechanism was successfully applied to an object for which it is fundamentally impermissible. Here, property fails not as an algorithm but as a morally justifiable principle.

9.6. Coexistence, Institutionalization, and Structural Coupling

The mechanisms described in these two chapters do not exist in historical isolation. Bureaucracy, money, and property are not alternative forms of organization among which societies choose, but structurally coupled solutions that mutually stabilize one another.

Bureaucracy enables the enforcement of property. Property in turn defines exclusive assignments of resources to individual actors and thereby creates the precondition for exchange. Money, finally, abstracts this exchange into a universal token and permits decentralized coordination over large distances.

Without bureaucratic enforcement power, property would not be stable. Contracts could not be enforced, claims could not be protected, debts could not be collected. Money would lose its reliability in such a context. It is structurally dependent on an authority that guarantees exclusivity and sanctions rule violations.

Conversely, large-scale bureaucracy is hardly capable of functioning without money. Central planning reaches its limits with growing complexity. The decentralized procurement of goods, the flexible allocation of labor, and the organization of differentiated value chains require a scalable coordination medium. Money assumes this function.

Property, finally, is neither exclusively market-economic nor optional. State systems also operate with exclusive access titles, even if these are institutionally rather than individually anchored. Public property is not communal access in the sense of the commons but an institutionalized form of exclusive control.

Structurally, a recursive relationship thus emerges: bureaucracy stabilizes property, property makes money meaningful, money finances and expands bureaucracy.

The mechanisms therefore complement each other not merely functionally but are mutually constitutive. They form a closed system of mutual enablement. Their historical robustness is explained not by normative superiority but by this structural coupling.

In societal reality R, these mechanisms do not remain neutral. They become institutionally anchored, generate asymmetries, and become carriers of power. Coordination mechanisms become mechanisms of domination.

Money and property in particular possess a pronounced tendency toward accumulation. Accumulated resources can be translated into political influence. Political power in turn stabilizes property relations and monetary advantages. A recursive dynamic emerges

in which economic and political power mutually reinforce each other.

The mechanisms developed in the historical S therefore structure not only production and value creation but, over the long term, also social order, the distribution of power, and scopes of action. Their combination produces stability — and at the same time systemic tensions that cannot be fully resolved within the same mechanism space.

Concluding Question. The world does not consist solely of value creation. Through which mechanisms are social coordination and order ensured outside of value chains?

10. Complementary Mechanisms of Social Order

In the preceding chapters, bureaucracy, money, and property were described as central ordering technologies of the system S. These mechanisms enable scaling, coordination, and division of labor in large, anonymous societies. They operate primarily through formal rules, abstract symbols, and institutionalized procedures.

These ordering technologies, however, are neither complete nor sufficient. Historically as well as in the present, they have always been embedded in further mechanisms that take effect where formal institutions reach their limits. Social order was never sustained by bureaucracy, money, or property alone, but always through an interplay of formal and informal structures.

This chapter is devoted to three such complementary mechanisms: family, reputation (with honor as a special case), and morality. What they share is that they do not operate primarily through formal procedures, but can be understood as functional responses to cognitive overload in large social systems. They reduce complexity not through institutionalization, but through proximity, collective observation, or self-commitment.

The following sections analyze these mechanisms not as cultural self-evidences or normative ideals, but as elements of a mechanism design that arises from the limited computational capacities of the human brain. They complement the ordering technologies

described earlier without replacing them, and make visible how social order is stabilized beyond formal institutions as well.

10.1. Family as a Substitute Mechanism of Social Order

Family in this context designates not primarily a biological or genealogical unit, but a small, manageable group within a large social graph. What matters is not kinship, but group size and social legibility.

A family is small enough that complete social observation is possible. Actions, motives, and reactions of those involved are directly perceivable by all group members. Social feedback occurs immediately, responsibility can be assigned personally, and behavior can be coordinated without formalized rules.

In this sense, a family can take on different concrete forms. A shared living arrangement, a rock band on tour, a small artisan group, or a close network of friends fulfill the same structural function under these conditions. The term "family" here designates an ordering algorithm in S, not a cultural or biological category in R.

Historically, this structure is a remnant from a phase in which societal complexity was low and the social graph overall remained

small. In this prehistory, nearly all social relationships were organized in family-like fashion. With growing societal size, this structure loses its general viability, yet remains locally effective.

Family therefore functions simultaneously as a historical relic and as a still-utilized substitute mechanism. It takes effect where abstract ordering technologies such as money, law, or bureaucracy do not function or function only insufficiently. This applies especially to the domestic sphere, to care work, emotional bonds, and long-term obligations that can only be represented institutionally to a limited extent.

The cultural embedding of family varies greatly across history and societies. Role models, rituals, and norms are expressions of this embedding in R. Strictly to be distinguished from this, however, is the underlying structure in S: a small, fully legible group as a means of stabilizing order under conditions of limited formal controllability.

10.1.1. The Advantages of Family as an Ordering Technology

The central advantage of familial structures lies in complete social legibility. Since the group is small, actions, motives, and reactions of those involved are directly observable by all members. Social feedback occurs without delay, responsibility is unambiguously assignable, and behavior need not be abstracted or formalized.

Family enables order without explicit rules. Coordination arises through proximity, repeated interaction, and implicit knowledge about the other actors. Norms are not codified but situationally adapted and continuously updated. This permits a high degree of context sensitivity that formal ordering technologies lack.

A further advantage lies in robustness against formal failures. Family structures take effect where money, law, or bureaucracy are unavailable or not meaningfully applicable. Especially in the domestic sphere, in care work, and in long-term obligations, family enables agency beyond contractual or monetary logic.

Finally, family permits a tight coupling of action and consequence. Since the effects of one's own actions are immediately experienceable, this structure promotes the assumption of responsibility without moral abstraction. Order arises not through external enforcement, but through personal bonds.

10.1.2. The Disadvantages of Family as an Ordering Technology

The advantages of familial order are inseparably tied to its small size. Family is not scalable. As soon as the social graph grows, complete legibility and immediate feedback are lost. As a general ordering principle, family is therefore unsuitable.

Due to this strong limitation, family is not suited for orchestrating complex value creation.

The strong personalization of relationships furthermore leads to dependencies. Since order rests on proximity, loyalty, and personal bonds, power asymmetries cannot be neutralized. Conflicts are difficult to externalize, as there are no independent procedures or formal authorities.

Family is moreover highly opaque. Norms are implicit, situational, and not explicitly justifiable. This impedes criticism, reflection, and systematic learning. Misconduct is rarely analyzed but processed emotionally, which can secure stability in the short term but block it in the long term.

Finally, familial order is strongly dependent on cultural embedding. Roles, expectations, and obligations are frequently naturalized and presented as self-evident. As a result, historical contingencies and cultural imprints can appear as immutable order. What stabilizes locally can have exclusionary effects at the societal level and displace alternative forms of order.

10.2. Reputation as a Substitute Mechanism of Social Order

10.2.1. Reputation as a Cognitive Relief Process

Reputation is a mechanism for the cognitive relief of actors in large social graphs. It reduces the effort of individual observation by shifting the monitoring of social behavior from individual actors to the community.

Instead of having to observe and evaluate all relevant edges in the social graph themselves, actors draw on aggregated information that emerges from distributed observations by others. Reputation thus replaces individual monitoring with collectively maintained statistics.

The relief effect arises not through reduction of the social graph, but through reduction of the necessary own observation. Complexity is preserved, yet informationally condensed and made retrievable.

10.2.2. How Reputation Works

Reputation emerges through the outsourcing of social observation to a multitude of actors. Each actor observes only a small segment of the social graph and collects local experiences with the behavior of others. These observations occur in a decentralized, unplanned manner and without complete overview.

The individual observations are socially accumulated. Through communication, sharing of experiences, and repeated interaction, local impressions condense into an aggregated status. This status is not the result of deliberate coordination but emerges as a byproduct of collective observation.

For the individual actor, reputation becomes retrievable. Instead of observing behavior themselves, they can access the condensed state generated by the community. Reputation thus functions as an interface between individual decision and collective experience.

The mechanism is statistical in nature. Reputation does not constitute a complete description of an actor, but a rough, lossy aggregation. Its function lies not in accuracy, but in sufficient reliability for the reduction of cognitive load in selecting cooperation partners.

10.2.3. The Advantages of Reputation as an Ordering Technology

The central advantage of reputation lies in its ability to reduce cognitive overload without simplifying the social graph itself. Complexity is preserved, yet informationally condensed. Actors can make decisions without having to observe all relevant interactions themselves.

Reputation enables order in open, large, and dynamic systems. Since observation occurs in a decentralized manner and aggregation need not be centrally controlled, the mechanism is highly scalable. It functions even where personal acquaintance, formal control, or institutional enforcement are absent.

A further advantage lies in the learning capacity of the system. Since reputation is based on repeated observations, it can adapt over time. Behavior is not judged once but continuously reassessed. Misconduct does not necessarily lead to permanent exclusion but can be gradually compensated through consistent action.

Reputation is moreover context-sensitive. It can operate domain-specifically and represent different aspects of behavior, such as

reliability, quality, or cooperativeness. In contrast to binary ordering techniques, it permits gradual differentiation and finer selection decisions.

Finally, reputation-based orders emerge with comparatively low institutional costs. Since sanctioning operates primarily through attractiveness and willingness to cooperate, no formal enforcement is required. Order is not imposed but results from the aggregation of collective experience.

10.2.4. The Disadvantages of Reputation as an Ordering Technology

The advantages of reputation-based order come with structural risks that result from its statistical nature. Reputation is necessarily a rough aggregation of distributed observations and thus susceptible to distortion. Individual events can be over- or underweighted, context is lost, and complex behavioral patterns are reduced to simple evaluations.

Since reputation rests on collective observation, it is subject to herd dynamics. An impression once established tends to be self-reinforcing, regardless of current performance or behavior. Both positive and negative reputations can thereby become path-dependent and difficult to correct.

Reputation systems are moreover manipulable. Since their value is high, incentives arise for the targeted influence of evaluations, for the simulation of behavior, or for the strategic damaging of others.

The quality of aggregation thus depends less on truth than on the robustness of the system against manipulation.

A further problem lies in the power over aggregation. Whoever decides which observations count, how they are weighted, and how reputation is made visible possesses considerable steering power. Reputation is therefore not neutral but always bound to infrastructure, platforms, or social gatekeepers.

Finally, reputation shifts responsibility from individual judgment to statistical results. Actors make decisions based on aggregated values without tracing their origin. Action appears rational yet can amplify systemic maldevelopments, as individual responsibility disappears behind collective statistics.

Addendum: Honor as a Cousin of Reputation

Honor can be understood as a closely related mechanism to reputation that operates under conditions of severely restricted information processing. Like reputation, honor serves cognitive relief by replacing individual monitoring with collectively maintained evaluation. The difference lies not in purpose but in the form of aggregation.

While reputation operates continuously, context-dependently, and gradually, honor is normatively condensed and binary. It compresses collective observation into a few morally highly charged thresholds. Honor does not determine how well someone acts, but

whether someone as a person is bearable within the community or not.

A classic example of such a code of honor is the Albanian *Besa*. The Besa designates a publicly recognized promise whose observance determines the social status of a person. Whoever keeps the Besa is regarded as honorable and trustworthy; whoever breaks it loses not merely reputation but their social existence within the community.

The Besa functions as an extremely low-complexity ordering technology. Instead of continuously evaluating behavior, monitoring concentrates on a few core moral actions. The community implicitly maintains a binary statistic: honor intact or honor lost. This strong compression enables order under conditions of minimal observability, yet comes with high escalation and low reparability.

Honor is thus not a precursor to modern reputation but its normatively condensed limiting case. It fulfills the same function of cognitive relief yet sacrifices information resolution in favor of maximum social effectiveness.

10.3. Morality as a Substitute Mechanism of Social Order

10.3.1. Preliminary Remark: Normative Relief under Cognitive Overload

In large societies, the complexity of the social environment ($|V| \gg k$) exceeds the cognitive processing capacity of individual actors. Most ordering techniques respond to this by regulating behavior through the observation of others: through sanctions, reputation, institutional control, or mutual expectation.

The mechanism considered here follows a different logic. It does not begin with the observation of others' behavior but with the self-description of one's own actions. In place of social perception, an internal rule takes effect: not the question of what others do or see, but how one's own behavior should look and what limits it must have.

This rule operates independently of social visibility and takes effect especially where external observation, sanction, or feedback fail. Orientation is directed not toward others but toward a generalized standard for one's own behavior.

In this sense, the mechanism functions as a default mode of normative orientation and enables agency even under conditions in which social control lapses.

10.3.2. Morality as a Rule System

Morality designates a system of generalized behavioral rules that applies independently of concrete situations and individual relationships. These rules formulate expectations for one's own actions and define permissible as well as impermissible behaviors.

Moral rules are not descriptive but normative. They do not describe how one acts but how one ought to act. Their validity is not tied to concrete observation but is presupposed as fundamental.

The rule system is decoupled from the individual subject: the actor follows moral rules not on the basis of observation or sanction but because the rules are internalized as a binding standard for one's own behavior. Morality thus operates primarily as self-commitment.

Formally, morality can be understood as a set of stabilized ought-rules that constrain action spaces without requiring situational deliberation or knowledge of the current environment.

10.3.3. How Morality Works

Morality fulfills its ordering function not through explanation but through reduction. It replaces complex social observation with simple, internally applicable rules.

By applying moral rules independently of situation, counterpart, and context, they relieve actors of continuous evaluation of the

social environment. Action becomes possible without having to anticipate the motives, expectations, or reactions of others.

Morality thus operates as a mechanism for constraining one's own scope of action. It defines in advance which actions are excluded and which are considered permissible. This pre-structuring reduces decision-making effort and enables agency under conditions of high uncertainty.

At the same time, morality stabilizes expectations in society. Since it can be assumed that moral rules are generally known, behavior becomes predictable even without direct coordination. Order arises not through coordination but through parallel self-commitment.

10.3.4. Morality and Ethics: Individual Action Software and Norm Production

Morality exists exclusively at the level of the individual actor. Each person possesses exactly one morality, understood as an internalized rule system that guides their concrete actions.

There is no collective or universally normative morality. What appears as societal morality is the result of synchronized individual moralities through shared ethical sources, institutions, and social enforcement.

Ethics, by contrast, designates the process in which norms are reflected upon, justified, and formulated. It does not operate in an action-guiding manner but generates normative offerings that can

be internalized by actors. Ethics is thus not itself morality but the source from which individual morality is fed.

10.3.5. Modes of Ethical Norm Production

Self-normative ethics produces norms without a claim to universal validity. It answers the question of how an actor can justify their own actions under given circumstances. The resulting norms are situational, context-dependent, and non-transferable, yet they always flow into individual morality.

Universal-normative ethics produces norms with the claim of general validity. It aims at scaling, synchronization, and social order. These norms, too, do not become directly effective but only through their internalization into the morality of individual actors.

10.3.6. Societal Development and Ethical Differentiation

Prehistoric Societies

In small, manageable societies ($|V| \ll k$), social complexity is directly observable. Self-normative ethics suffices to orient individual action.

Ethics and morality largely coincide, since norm production, internalization, and social feedback occur immediately.

Exceeding the Cognitive Threshold

With growing societal size, the social environment exceeds the cognitive processing capacity of individual actors. Direct observation becomes impossible, feedback is delayed, responsibility becomes diffuse.

The separation of lifeworld and system world emerges.

Universal-Normative Ethics as a Response to the System World

The system world generates blind spots: actions unfold consequences that are no longer surveyable. Universal-normative ethics attempts to close these gaps by formulating universally valid norms.

These norms are transferred into individual morality through education, religion, law, and institutions and synchronize behavior without direct social observation.

The Axial Age as a Culmination Point

The concept of the Axial Age goes back to Karl Jaspers and designates a historical period roughly between the 8th and 3rd centuries BCE. During this period, new forms of normative reflection emerge in largely independent world regions, which continue to shape ethical and religious thought to this day.

The Axial Age includes, among others: Confucius and Laozi in China, the Upanishads, Buddhism, and Jainism in India, the Hebrew prophets in the Near East, and Socrates, Plato, and Aristotle in the Greek world. Despite great cultural differences, these thinkers and schools develop structurally comparable answers to fundamental questions of human action.

What these approaches share is that they no longer derive norms primarily from tradition, myth, or immediate social order, but from explicit reflection. Ethics becomes visible as an autonomous process that formulates general standards and claims validity beyond local contexts.

Within the framework of this book, the Axial Age can be understood as the historical culmination point of universal-normative ethics. Large societies had by this point reached a complexity that overwhelmed direct social observation and feedback. Actions unfolded consequences that were no longer surveyable for individuals.

Universal-normative ethics responds to this situation by formulating generalized rules that are intended to apply independently of concrete relationships. These rules aim not at situational appropriateness but at scalability and synchronization of individual morality in anonymous societies.

The nearly simultaneous emergence of these forms of thought on different continents is therefore no coincidence. It is an expression of a shared structural problem: the cognitive overload of growing

societies and the necessity of stabilizing order beyond direct social control.

Religious Embedding of Morality and Ethics

Morality and ethics belong to those elements of a social system that are most difficult to identify. This is because they are not primarily anchored in explicit institutions or procedures but operate deeply embedded in social reality (R). They are transmitted through culture, practices, rituals, traditions, and over long periods of time especially through religions.

This deep embedding impedes their analytical separation from everyday action and social self-evidence. While law, money, or bureaucracy are visible and formalizable as distinct ordering technologies, morality and ethics frequently operate implicitly, embodied and habitualized.

Among these carrier media, religious embeddings hold particular significance. Religion does not function here as an ideological sedative or as an impediment to political progress. Historically considered, it was above all a necessary foundation of public order under conditions of high societal complexity.

Religious systems frequently ground moral rules in comparatively simple reference worlds. God, paradise, afterlife conceptions, or a strongly symbolic imagery provide low-complexity ordering models. These justificatory worlds are expressly not anchored in the real social world.

The reason for this lies not in detachment from reality but in functional necessity. The real social world was characterized by delayed, non-linear, and distributed causalities and was thus unsuitable as a normative reference. An ethical justification in the real world would have required a degree of overview, attribution, and understanding that was cognitively unachievable.

Ethics therefore requires a low-complexity justificatory world in which actions can be unambiguously evaluated, guilt and merit clearly assigned, and normative expectations stabilized. Religious artificial worlds fulfilled precisely this function and made it possible to durably synchronize morality as individual action software under conditions of structural overload.

10.3.7. Advantages of Morality as an Ordering Technology

Morality massively reduces cognitive demands: by mapping complex social situations onto predefined ought-rules, it enables agency without situational observation, deliberation, or knowledge of others' motives. Behavior thereby becomes predictable without permanent coordination — order arises through parallel self-commitment. Since moral rules are effective independently of personal proximity, this mechanism scales into large, anonymous societies where direct social control fails.

Universal-normative ethics furthermore enables the synchronization of a multitude of individual moralities from shared normative offerings and generates societal coherence at low institutional costs.

Order is maintained not through coercion but through internalization.

10.3.8. Disadvantages of Morality as an Ordering Technology

The functional advantages of morality come with structural disadvantages. Precisely because morality reduces complexity, it necessarily loses sensitivity to context, situation, and side effects. Actions are evaluated as right or wrong independently of concrete circumstances, even where a differentiated deliberation would be appropriate.

Morality shifts responsibility from the acting agent to rule systems, commandments, or superordinate authorities. In place of one's own judgment comes orientation toward predetermined norms. Action can thereby appear morally correct without responsibility for real consequences being assumed.

Moreover, morality blocks systematic learning. Since moral rules are normatively fixed, they are not falsifiable. Deviations are sanctioned rather than used as feedback for adaptation. Errors generate guilt, not insight.

Universalistic morality furthermore generates a structural overload. Since its rules apply independently of reality and context, failure is inevitable. The discrepancy between simple norm and complex world produces permanent deviation, guilt, and the need for justification.

In conflicts, morality has an escalating effect. Deviation appears not as difference but as injustice. Conflicts are moralized, not negotiated. This increases polarization and legitimizes exclusion rather than understanding.

Finally, morality displaces other ordering technologies. Where moral self-commitment provides order, law, procedures, and institutional authority become secondary. Morality thus operates not as a complement but as a competitor to other forms of societal governance. What stabilizes order can simultaneously block its further development.

10.4. Summary and Outlook

None of the mechanisms described here is capable of producing order on its own. Family, reputation, morality — just as bureaucracy, money, and property — have historically never functioned in isolation but always in interplay. They are all mechanism design elements that do not emerge from political programs but from the limited computational capacities of the human brain: functional responses to overload, opacity, and lack of overview in large social systems.

This demonstrates that S exists as an autonomous system — filled with concrete mechanisms, not reduced to ideology or cultural narrative. The enormous stability of these mechanisms has sustained social order over a period of two to six thousand years after humans had left the state of complete social surveyability.

Concluding Question. But what happens when S changes substantively for the first time? How does social order change when those mechanisms that have compensated for cognitive overload over millennia lose their effectiveness or are replaced by new structures?

Part III.

The Digital and its Precursor

11. The Digital

11.1. The Digital as a New Mega-Epoch

We have seen that social reality R is not immediately given but is constituted through social mechanisms S. We have further seen that these mechanisms have remained remarkably stable in their basic forms over millennia.

With digitalization, this finding changes. For the first time, the set of social mechanisms is substantively no longer the same. A new S' emerges that cannot be understood as a continuous variation, further development, or recombination of the previous S.

With S', social reality necessarily changes as well. A new R' emerges whose structure, stabilities, and lines of conflict are no longer comparable to the previous R.

We designate this new condition of human order as *the Digital*.

The Digital is not a new phase within history but a mega-epoch of its own kind. Human history from prehistory through the first decades of the 21st century constitutes a single coherent mega-epoch: political, economic, and cultural manifestations varied considerably, yet unfolded within a shared structural framework of social coordination whose basic mechanisms remained stable. The internal diversity of history obscures this structural commonality without dissolving it.

11.2. The Epistemic Exoskeleton

The structural core of the Digital lies not in individual technologies but in a transformation of the cognitive boundary conditions of human action.

In the historical S, individual observational capacity k was biologically limited. Communication was local, storage scarce, sensory perception organic, and pattern recognition individual. Formally, across large stretches of history:

$$|E| \gg k.$$

Social mechanisms such as bureaucracy, hierarchy, or money arose as surrogate constructions to maintain the capacity for action under this structural blindness.

With digitalization, this boundary condition changes fundamentally. Digital technology functions as a *cognitive and epistemic exoskeleton*. It externalizes central functions of the brain:

- global communication,
- (practically) unlimited external storage,
- technically augmented sensory perception through digital recording,
- algorithmic pattern recognition in large datasets (AI, big data).

This gives rise to an augmented observational capacity

$$k' = k_{\text{biologisch}} + k_{\text{technologisch}}.$$

Thus k' advances into an order of magnitude where:

$$k' \approx |E|.$$

For the first time since the crossing of the cognitive threshold, complete social legibility becomes technically realizable again — not through individual perception but through systemic aggregation.

With this, the structural necessity of the historical surrogate mechanisms comes to an end. They may continue to exist but are no longer without alternative. The Digital therefore marks not a variation within history but the reactivation of a structurally new possibility: global social legibility under non-biological computational conditions.

11.3. The Transition to the Digital

The transition does not proceed as a gradual shift but as a change of state space. The previous S is displaced by a new S'; the social reality R' constituted by it can no longer be understood as a variation or continuation of the previous R.

The structural scarcity that made the mechanisms of history necessary — $k \ll |E|$ — ceases to hold with $k' \approx |E|$. This transition affects not individual institutions but the basic forms of coordination, valuation, and stabilization.

The Digital is not a homogeneous state but a space of the possible: what unites its manifestations is not their institutional form but the shared structural framework under which social order arises.

Concluding Question. If the Digital is an autonomous mega-epoch whose social reality R' is constituted by a new set of social mechanisms S', then the next question concerns not individual technologies or institutions but the structure of these mechanisms themselves:

What elements compose S', and in what fundamental respects do they differ from the social mechanisms of history?