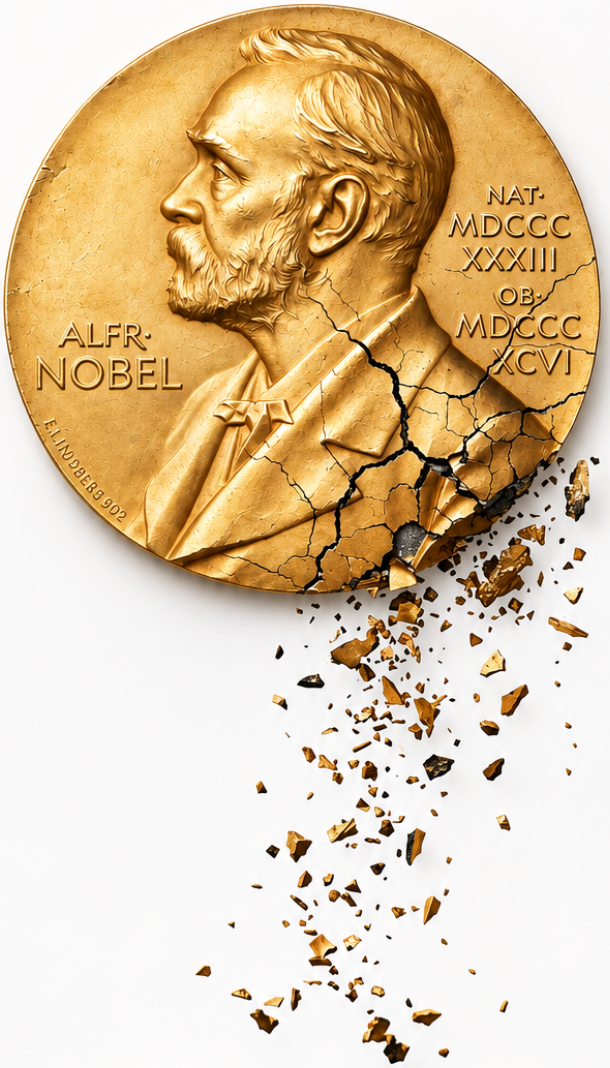
SPACE TIME

A CONTINUUM OF ERRORS



BY C. H. F. WARNKE

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TRACTATUS PRINCIPIO

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PART I — INTRODUCTION

Archibald and the Error of the Third Dimension

As a child I watched an animated series called *Archibald the Space Traveller*. Together with his dog, Archibald travelled through space and, in one episode, landed on a most peculiar planet: its inhabitants were two-dimensional.

For a child who experienced his own world as three-dimensional without giving it a second thought, the idea was fascinating. A whole world without a third dimension! How could those beings live and move without the spatial depth I had until then regarded as an almost self-evident prerequisite of any movement?

Archibald arrived as a visitor from a three-dimensional world and encountered beings whose reality was confined to two dimensions. At least that was how I understood the story. I had completely missed something remarkable: Archibald himself was two-dimensional.

Not only the inhabitants of the strange planet but Archibald, his dog, his spacecraft and the entire universe through which they travelled appeared on a two-dimensional picture surface. I was therefore watching a two-dimensional representation of an apparently three-dimensional world, in which an observer depicted as three-dimensional discovered another, supposedly two-dimensional world. And it was precisely his three-dimensionality that I had taken for granted.

Yet the picture surface itself possessed no corresponding spatial depth whatsoever. That depth arose only in my perception. But even this was not quite the point.

The Film That Does Not Move

Consider an ordinary motion-picture film running at twenty-four frames per second. Each image presents a particular, internally complete arrangement. A person stands in a particular place, an object has a particular position, a landscape takes on a particular form. Nothing moves within the single frame. Only through the perception of those frames in their ordered succession do we experience motion.

We see a person walking and a spaceship flying, although every single image presents merely a determinate appearance. We experience continuous motion that is contained in none of those individual images by itself. Yet we do not doubt for an instant that Archibald really is travelling through space. Of course a film requires temporal projection. Whether that principle also explains reality itself is another question.

For if we understood the world merely as a succession of cosmic still frames, we would already have to assume an external time in which these images could succeed one another. Time would not have been explained. We would simply have invented an invisible film projector.

The Observer and His World

Our investigation therefore begins not with motion but with distinction: an observer distinguishes himself from his world. Yet neither the observer nor the world need be presupposed as two finished objects existing independently of one another.

They appear as the two poles of one and the same distinction.

Observer | World

This distinction has a remarkable property. The observer distinguishes not only his world from himself but also his own relation to that world.

The distinction itself is distinguished again.

Difference refers back to itself.

The *Tractatus Principio* denotes this operative self-reference by:

$$\Delta := |(|)$$

This self-referentiality is not an event that would first have to take place within an already existing time. It is the condition under which different relational configurations can become mutually readable at all. The *Tractatus* calls such a complete relational configuration a **Frozen Frame**. Nothing moves within such a frame. It is not an infinitesimal interval during which reality briefly stands still. It denotes a complete order of distinctions that presupposes no temporal duration of its own.

Only when the observer relates different complete relational configurations to one another does the coherent order arise that we experience as temporal continuation. Recurring differences appear to us as enduring objects, altered relations as motion, and

the coherence of those alterations, finally, as time. Time does not bring distinctions into being. It is a reading of their self-reference.

The Surface of Reality

Let us return to Archibald.

His three-dimensional world appears on a two-dimensional surface. His motion appears through the relation between motionless pictures. Both appearances are immediately real to the viewer, even though neither requires a third spatial dimension in the picture surface nor motion within a single frame.

What, then, if our own three-dimensional perception were also a geometrical reading of a more fundamental self-relation?

What if the depth we experience did not designate an independent third fundamental dimension but a perspective on the recursive depth of a topological-geometrical relation?

Then the surfaces of things would not be mere outer shells concealing progressively smaller material objects. Each further examination of a surface would bring forth distinguishable surfaces once again. We would not discover a final content existing without relations; we would repeat the original distinction under altered conditions. Instead of countless mutually independent spaces with concealed interiors, there would be one connected relational order whose self-distinctions appear as different surfaces, objects and depths. And now we can turn the whole consideration around once more.

Why a Photograph Is Possible at All

We are accustomed to treating a photograph as an image of reality. The world is there, we point a camera towards it and capture a fragment for a brief instant. This seems perfectly obvious. But it already assumes what we ought to be explaining.

Why can a world appear in a two-dimensional image at all?

Why can spatial relations be recorded on a surface without losing their spatial readability entirely?

And why can we recognise in a motionless photograph not only forms but objects, distances and even indications of movement?

During exposure, a camera registers a particular light relation. Its optics, orientation and recording surface determine which differences can be stabilised as an image. What we obtain is therefore not simply a miniature world but a particular, fixed reading of its distinguishable relations. And yet we recognise a spatial world in this two-dimensional representation. We see nearness and distance, foreground and background, bodies and objects.

Sometimes a single photograph is enough for us even to recognise movement: a person jumping, an object falling, a treetop bending in the wind.

We do not see movement itself.

We read a visible relational configuration in connection with other possible configurations. Thus the photograph shows us not merely how a three-dimensional world can be represented two-dimensionally. It shows that spatial readability need not be identical to the number of dimensions of its representation.

And so our original question is reversed.

Perhaps photography is possible not because reality consists of finished three-dimensional objects that can be projected onto a plane. Perhaps we ought instead to investigate whether photography is possible precisely because spatial objecthood is itself already a stable reading of relational distinctions. In the language of the *Tractatus*, a photograph would not be a piece of reality lifted out of time. It would be the fixed appearance of a particular measurement relation, readable as a complete, distinguishable image-order.

And this is the deeper meaning of the Frozen Frame. We can recognise a world in a motionless image because movement, objecthood and spatial depth need not be present in that image as finished contents. They become readable through distinctions and their relations.

This does not prove the entire ontology of the *Tractatus*. But it leads directly to the question from which our investigation begins:

If a two-dimensional representation is enough for us to recognise a three-dimensional world, what, exactly, is the third dimension?

Is it an original property of reality?

Or a perspective on the self-reference of distinction?

And if time is experienced only through the coherent relation between complete relational configurations, why do we presuppose a four-dimensional spacetime substrate in order to explain these appearances?

Perhaps the error does not begin in the equations of physics. Perhaps it begins when we mistake their geometrical readings for reality itself.

Archibald believed he had discovered a two-dimensional planet.

Perhaps he should first have asked why his own world fitted onto a two-dimensional surface at all.

PART II — SPACE AS A READING OF DIFFERENCE

CHAPTER 01

1. The Confusion of Object and Position

We ordinarily regard space as something in which objects are located. A table stands in a room; one observer stands in front of it while another looks at it from the side. We explain their different perspectives by their different positions in three-dimensional space. But this already presupposes what we are trying to explain.

We assume that the table is a finished three-dimensional object, that the observers are independent bodies, and that a space exists in which their positions differ. On that basis their perspectives can be calculated perfectly well. Yet we have not explained why spatially different perspectives can arise at all.

For this we must begin with distinction itself.

In the *Tractatus Principio*,

denotes pure distinction.

It is not a line drawn in already existing space. Initially it denotes neither length nor width, neither direction nor distance. It is the condition under which something can appear as distinct from something else at all.

Its polar reading is:

A|B

A and B do not designate two already finished objects.

They are the two distinguishable sides of the same relation.

Whether we call them observer and world, observer A and observer B, or even hand and table does not alter the fundamental structure.

It remains the same distinction.

Even if we speak of two observers, we have not introduced two independent origins that must subsequently be connected. For their distinguishability is already a reading of A|B.

The number of observers does not change the original relation. It denotes different possibilities of reading that same relation.

CHAPTER 02

2. The Self-Reference of Difference

The activity of difference does not end with making two poles distinguishable. Difference can refer to its own distinction. Not only can A be distinguished from B; the way in which A and B are distinguished can itself be distinguished.

Difference distinguishes its own difference.

The *Tractatus Principio* denotes this self-reference by:

$$\Delta := |(|)$$

This is not a process that begins after the original distinction in an already existing time. Pure distinction, its polar reading and its self-distinction operate simultaneously and recursively within one another. That is precisely what allows different perspectives on one and the same relational order. A perspective is not yet a location in a finished space. It is a particular fixation under which the relation is read. The possibility of another perspective already belongs to the self-reference of that same distinction.

This requires no second observer as an additional cause. Another observer can embody a different reading of the same order, just as a single observer can alter his own reading.

In both cases the original relation remains the same.

Multiple observers do not create multiple original realities. The self-reference of difference permits different readings of one common reality.

CHAPTER 03

3. The Table as the Symbol 1

To make this clearer, consider a table. We designate the stable relational form recognisable as that table by the symbol:

1

The one does not assert that the table is an indivisible material unit. It is the chosen designation for the relation that remains readable as the same table from different perspectives. We now need a way to mark different reading positions without already presupposing spatial coordinates.

Here the comma takes on a special meaning.

In our notation it does not merely separate the whole and fractional parts of a numerical value. It marks the shift from the designated relation to the position from which it is read.

Consider:

1,1

and

1,5

Both expressions contain the same one.

The table is still designated as the same relational form.

Only the reading position after the comma changes.

The first notation designates the table from reading position 1; the second designates the same table from position 5. Thus two distinguishable appearances can be read without having to assume two tables. Equally, we obtain two reading positions without first assuming a three-dimensional space.

The one carries the recognisable object relation.

The comma marks the change of reference level.

The number that follows designates the fixation under which that relation appears. The object remains readable as a relation while its perspective differs.

CHAPTER 04

4. The Difference Lies in the Reading

Now let us assume two observers.

Observer A reads the table as:

1,1

Observer B reads it as:

1,5

Conventional geometry would say that A and B occupy two different locations in an already existing space. But we can describe the situation without that assumption.

Both readings refer to the same one.

They differ in their fixation.

The relation is:

1,1 | 1,5

What is being distinguished here?

Not two independent tables, nor two separate worlds, but different reading positions of the same object relation. And the difference between these reading positions is once again a distinction within the same relational structure.

Thus difference refers back to itself once more:

Δ := |(|)

We therefore require no additional space to relate the reading positions. Their distinctness is itself a reading of the original relation. It is important not to rush into subtracting the digits after the comma as though they were ordinary numbers. Reading positions 1 and 5 alone do not imply a spatial distance of four units. That would already require a scale and a rule under which different reading positions could be measured as distance.

So far we know only their difference.

Their spatial significance must emerge from the relation between the two readings. The difference between reading positions is more fundamental than the distance we later read from it.

CHAPTER 05

5. How a Spatial Object Appears from Reading Positions

Observer A sees the table under a particular fixation. Its front may be especially clear to him while another side remains hidden. Observer B views the same table under another fixation. A side face may now become visible while the previously visible front is foreshortened. The appearances differ, yet we can recognise them as appearances of the same table. This requires the relation between the readings to be preserved. Any two arbitrary pictures do not automatically make a spatial object.

Only if their differences can be understood as mutually compatible readings of the same relational structure does a common spatial interpretation become possible. The table's recognisability is therefore not simply an attribute of a finished body that we have to presuppose. We can investigate it as an invariance between different reading positions.

The one denotes this recognisable relation.

The places after the comma distinguish its modes of appearance.

It makes no difference here whether these readings are performed by two observers or by one observer adopting different fixations.

Difference remains self-referential.

And this makes the emergence of spatial objecthood understandable.

We regard a table as a three-dimensional body because we can read its various possible views as appearances of one stable relation. We never see every side of the table simultaneously. Yet the other reading positions remain accessible as possible continuations of our present reading. The object's spatial completeness arises from this belonging-together. What we understand as a body is the stable readability of a relation across different perspectives.

CHAPTER 06

6. The Third Dimension Is Not an Additional Substrate

We can now return to the question of space. In the *Tractatus Principio*, the fundamental geometrical order is developed from positing, distinction and the relations among distinctions. Volume II describes these readings as radius, diameter and triangle. Volume VI traces spatial appearance back to the observer-related depth-reading of a two-dimensional relational network. Combined with our notation, this provides a more concrete approach. The one designates a stable relation within the structure; the comma opens its reading under a particular fixation.

The number following it makes that fixation distinguishable.

Different fixations do not necessarily generate different objects.

They alter the appearance of the same relation.

And insofar as these appearances remain mutually compatible, a depth of reference becomes readable—what we ordinarily call the third spatial dimension. The third dimension would therefore not be an additional original extension that first had to be added to a surface, but the spatial reading of a relational order's self-reference. An object's surface would then not merely be the outer limit of a finished three-dimensional body.

It would be a particular appearance of that relation.

What we call the back, an interior or spatial depth would, under different fixations, become distinguishable again as a surface or

partial surface. The connection need not disintegrate into several independent geometrical planes. The same relational order unfolds in its various readings. Depth is not necessarily located *behind* the surface. It becomes accessible in the surface's other possible readings. This suggests one topological-geometrical self-relation from which differing spatial appearances can arise.

We still have to show which relations between reading positions remain invariant and how their coupled variability can produce a measurable three-dimensional order. But we need not presuppose three-dimensional space as the foundation of that explanation.

CHAPTER 07

7. Photography as a Particular Reading Position

Our photograph can now be understood more precisely.

Suppose we photograph the table from reading position 5. The photograph shows a particular appearance of the relation:

1,5

It does not contain all the table's other possible readings. Yet we recognise the depicted object as a table.

Why?

Because we can connect its visible appearance with other possible reading positions of the same relation. We know that another photograph would present the table differently. We could examine a side, photograph the back or choose a different perspective.

The appearances change.

The recognisable relation is preserved, insofar as the readings remain compatible. The photograph is thus not a miniature three-dimensional world enclosed within a two-dimensional surface. It is a stabilised appearance under a particular reading fixation. The third dimension need not be contained in the image itself. It is inferred from the relation between the visible image and the other possible readings of the depicted connection. Here we return to our introduction: Archibald appears as a

three-dimensional space traveller on a two-dimensional picture surface.

His spatial appearance does not arise because the picture surface itself has a third extension. It arises because the represented differences can be read as spatial relations. A film additionally connects different complete image configurations, which we experience as motion. Whereas a photograph reveals the spatial readability of a single registered appearance, film shows how connecting different complete appearances can be experienced as temporal continuation.

Both bring us back to the same basic question:

How does the self-reference of a difference become a reality readable in space and time?

CHAPTER 08

8. From Notation to Self-Relation

We now have a starting point that does not yet presuppose finished space.

The one denotes the table as a recognisable relation.

The comma marks the change to the reading position.

The following number designates a particular fixation.

We can therefore write two different readings of the same table as:

```
1,1 | 1,5
```

The two appearances remain distinguishable while their common relation is preserved. Distinguishing between these readings is again self-distinction within one order.

Thus we return to our origin:

```
Δ := |(|)
```

The mathematical task now becomes precise.

We must determine under which conditions different reading positions preserve the same relation, how their differences relate to one another, and when these differences yield a stable geometrical reading of depth.

Only then can distance be derived.

Only then can a spatial position emerge as a measurable quantity. Only then can we develop an unscaled geometry whose spatial reading has not already been built into its assumptions. The aim is not to use the digits after the comma as disguised coordinates. It is to make visible the relation that permits a coordinate reading in the first place. The table is not first situated at a position in space. Its position is a reading of the relation in which it appears as a table.

Space is not a container holding those different readings together.

It is their geometrically readable self-relation.

CHAPTER 09

9. The Physical Reading of Number

Let us return once more to the table.

We designated it by the one and distinguished two reading positions:

1,1 | 1,5

Ordinarily we would treat this as a relation between two numbers, 1.1 and 1.5, whose arithmetic difference is 0.4. But that would already be a mathematical interpretation without asking which relation the numbers designate.

The *Tractatus Principio* offers another approach.

In Volume I, the decimal point is not understood merely as the separator of an ordinary decimal number. The sign |. denotes a **scale flip**: a change of reference level within the same numerical relation.

Applied to our example, we write the two readings as:

1|.1

and

1|.5

In this geometrical working notation, the first one denotes the table as a recognisable relational form. The scale flip opens

another reference level. The following digit designates the position from which the same relation appears.

The one itself has not been altered.

What changes is the way it is read within the structure.

The Observer as Fixation

Volume II designates the observer by ¤.

The sign does not name an independent substance standing outside reality. It denotes the relational reference point from which distinction appears as perception.

Volume II distinguishes the directions of unfolding and folding back:

$0|_{+}\Delta$ – expansion

$0|_{-}\Delta$ – contraction

$0|_{=}\Delta$ – equilibrium of perception

These directions do not designate independent forces or spaces.

They are different readings of difference's self-reference.

One relation that Volume II formulates explicitly is decisive here:

$$0|(A|_{+}\Delta) \equiv 0|(B|_{-}\Delta)$$

The two sides display the same relational order under opposite points of reference.

What changes is the orientation of the reading.

What remains common is the self-relation preserved under both orientations. This explains why differing observer perspectives do not demand different original realities. The observer is himself a fixation within the structure. A different fixation makes another aspect of the same structure readable. The distinction between reading positions is therefore not something we must first explain through an existing space.

It belongs to the self-reference of the relation.

The Table Remains the Same—Its Reading Does Not

Consider again:

1|.1 | 1|.5

Up to now these have appeared as two readings, each beginning with the one.

But the duplicated one is instructive.

We do not have two tables.

We have the same relation recognisable as a table under two reading positions.

Why, then, should we write the one twice?

If both readings return to the same self-relation and can be read together within it, we may contract their representation:

1|.1 | 1|.5

becomes:

1|.1|.5

The one need not appear twice because it denotes the common relational form. The reading positions remain distinguishable but become readable within the same contracted relation. This differs fundamentally from ordinary arithmetic. We have neither added nor subtracted the numbers 1.1 and 1.5, nor produced a third object out of two independent objects. We have made explicit the common self-relation of different readings.

This contraction does not mean that arbitrary expressions of the same numerical value are interchangeable. It is meaningful only where the readings actually return to the same relational form and are mutually compatible.

The expression

```
1|.1|.5
```

thus designates the table's joint readability under the two distinguished fixations.

What remains invariant?

The one as the recognisable relational form.

What changes?

The reading position.

What is added?

Not another object, but an explicitly readable relation between different perspectives. For an observer who perceives the table from position 1, position 5 is initially another possible perspective.

When he adopts that perspective, no second table appears.

Instead another side of an already distinguishable relation becomes accessible.

The unity of the connection is preserved.

And that is precisely what makes spatial objecthood possible.

The table can appear as a spatial body because its different readings are not unconnected pictures.

They remain bound by their common self-relation.

From Scale Flip to Spatial Depth

We can now grasp the scale flip more precisely. Reading positions .1 and .5 designate different fixations within the same relational order. Changing between them is not the motion of a finished table through an already existing space.

It designates an altered reading of the same structure.

The other reading position may reveal another surface.

A previously hidden side can come into view.

A previously visible face may appear foreshortened.

One orientation can be replaced by another. Yet these appearances remain connected as long as they can be traced back to the same self-relation.

That is exactly what our contracted notation expresses:

1|.1|.5

We no longer have to treat the two perspectives as separate objects or positions inside an already given space.

Their distinctness is readable within a common relation.

This opens a decisive possibility for our concept of space:

An object's depth can be understood as a geometrical reading of the relations among its possible appearances. We need not presuppose depth as an additional spatial extension. This also gives greater precision to the idea of a single topological-geometrical surface. The table's different sides are not independent realities assembled inside a spatial container. They are different readings of an order that distinguishes itself. Further surfaces appear through altered fixations within that order.

The observer remains part of the same relation.

Whether one observer changes his perspective or two observers read the relation differently makes no difference to the original structure.

It remains:

$$A|B$$

And, in its self-reference:

$$\Delta := |(|)$$

The different spatial readings therefore form no additional origins. They designate different perspectives on the same self-reference.

The Decisive Reversal

Ordinarily we would say:

Because the table is three-dimensional, we can examine it from different perspectives.

Our investigation reverses the direction of explanation:

Because the same relational order remains differently yet coherently readable under different fixations, it can appear as a three-dimensional object.

The contraction

1|.1 | 1|.5 → 1|.1|.5

makes this immediately visible.

The one is not doubled.

The reading positions are not declared independent spatial coordinates.

They remain different determinations of the same relation.

Nor may we immediately equate them with metric distances. The digits 1 and 5 alone do not imply a measured distance. Only after the directed relations among their readings have been worked out can a geometrical measure of distance arise. This is precisely why the notation of the *Tractatus* is useful: it lets us read the recognisable relational form, the reference-level change and the different fixations together without presupposing them as independent things.

Our original question now becomes concrete:

How can the self-relation among different reading positions within one relation give rise to a stable, three-dimensionally readable geometry?

This is where the actual calculation of space begins.

CHAPTER 10

10. Number Is Not the Origin of Motion

Before continuing we must rule out a possible misunderstanding.

We designated the table by the one and distinguished its reading positions by digits following a scale flip:

1|.1|.5

This might suggest that we presuppose numbers and then construct the spatial world out of them.

That would be a fundamental error.

For in the *Tractatus Principio,* neither mathematics nor physics begins with number.

They begin with difference.

Its polar reading is:

A|B

And its operative self-reference:

Δ := |(|)

These three orders do not operate as successive steps in time. They are different orders of the same distinction, acting simultaneously and recursively. Only through this self-reference

do recurrence, orientation, depth of reference and stable readings become possible. What we subsequently call a number is one such reading. We therefore do not use numbers to bring relations into being. We use numbers to make readable a relational order that has already emerged from distinction.

The One Is Not a Presupposed Table

When we designate the table by one, we do not claim that the number 1 creates an object. Nor do we claim that the table is originally a mathematical unit.

The table is a recognisable mode of appearance of a relation.

Only afterwards do we denote this recognisable form by the visible mark 1. The one is not a prerequisite of the table's existence but the selected reading of its relational recognisability. The same applies to the digits used to distinguish its reading positions. They are neither independent places nor ready-made coordinates.

They are visible addresses of distinguishable fixations.

What the Scale Flip Means

The sign |. must not be misunderstood as an additional fundamental operation.

Volume I of the *Tractatus Principio* develops the decimal point as a scale flip: a shift in perspective to another reference level of the same numerical relation.

When we write:

1|.1

and

1|.5

we are using this previously developed possibility of reading.

The common one denotes the recognisable relational form.

The places after the scale flip mark distinct fixations of its reading.

Since there are not two independent tables, we may contract the shared relational form in our working notation:

1|.1 | 1|.5 → 1|.1|.5

However, this contraction is permissible only if both readings can actually be traced back to the same relational order.

The common digit alone is insufficient.

Two arbitrary appearances do not become identical simply because we label both with a one. The contraction must express a preserved self-relation, not substitute for it.

The Intermediate Readings Do Not Create Time

Consider a possible continuation:

1|.1|.2|.3|.4|.5

Here a second danger arises.

One might imagine that the numbers 1, 2, 3, 4 and 5 already contain a temporal sequence and therefore bring motion into being.

But this, too, would be wrong.

The numerical sequence does not generate continuation. A directed continuation can be made readable through a numerical sequence. The mere arrangement of digits does not prove that these reading positions are connected in precisely that order. The self-referential operation must sustain a corresponding directed relation. Its trace must preserve which reading is connected with another and in what manner. Only then can the succession be read as motion. The digits are visible marks of this order, not its cause.

Here we encounter the Frozen Frame from Volume II again.

Every complete relational configuration is motionless in itself.

What appears as motion is the coherent connection of different complete relational configurations through the observer's self-measurement. When that connection is read in a directed manner, we experience temporal succession. Yet the directed connection requires no external time to set it going.

Time is its experienced reading.

Spatial and Temporal Readings of the Same Self-Relation

We can now distinguish two modes of appearance.

Under a spatial perspective, different fixations of the same relational order appear as different views and locations of an object. Under a temporal perspective, the directed connection between those fixations appears as change. We therefore need not first draw a number line and assemble motion out of its points. Nor do we require a three-dimensional coordinate scheme in which reading positions are already fixed as places.

Our investigation begins prior to both representations.

It begins with distinction and its self-reference.

Only afterwards do numbers serve to represent the different readings of this self-relation.

This also changes what we mean by calculation.

We are not seeking the number to assign to an already existing position. We seek the relation among distinctions that remains preserved when the reading perspective changes, and the directed continuation that becomes readable from it. Only after that may a numerical difference appear as a measure.

Only after that may spatial distance be calculated.

Only after that may an ordered continuation be read as a measure of time. We do not explain space and time through numbers. We investigate how number, space and time become different readings of the same self-reference.

CHAPTER 11

11. Measure as a Change of Reading

We represented the different perspectives on our table as reading positions of the same relation.

Their common connection is:

1|.1|.5

Until now we have merely identified their different fixations. We do not yet know what measures the change in reading position. Ordinarily we would measure the distance between two positions, using an existing spatial scale such as a metre. But that would again presuppose the very space whose emergence we wish to explain.

We therefore have to determine our measure differently.

Initially our measure is the accomplished change of reading itself.

Measuring an As-Yet-Open Position

Suppose an observer reads the table under fixation .1. We want to investigate its relation to another reading position that has not yet been determined.

We denote this open position by x.

Our question is:

1|.1|x

The one still designates the common relational form.

.1 designates the present reading fixation.

x is not a position already found in space. It denotes the open determination of another reading to which the present one is to be related.

Now we perform the measurement.

The observer determines his position anew within the relation to his world.

The *Tractatus Principio* describes this original measurement as the observer's self-measurement:

¤|World

Here the observer is not measuring an object independent of himself from somewhere outside the relation.

He determines his own place within the structure of differences.

Suppose the measured reading configuration yields:

x = .5

Then the determined relation is:

1|.1|.5

A difference has now been accomplished.

The initial reading .1 and the measured reading .5 are determined within the same relational form.

But what is the measure of this change?

Four Steps of Difference

We can consider the measured relation under a directed continuation.

If we choose the reading in which the positions are connected through distinguishable intermediate configurations .2, .3 and .4, we obtain:

1|.1|.2|.3|.4|.5

Here we distinguish four transitions:

.1 → .2

.2 → .3

.3 → .4

.4 → .5

The number four was not introduced as a presupposed physical length. The 4 is a symbol for 1 + 1 + 1 + 1. Each one denotes a distinguishable enactment of difference. Nor is the plus sign an original arithmetic operator that first produces the steps. It makes visible their repeated continuation, here read expansively. We therefore did not start with the number four and manufacture four steps out of it.

We have four distinguished enactments whose joint reading we denote by 4. The number designates the reading of the recurrence of difference, and must not itself be assumed as the prerequisite for that recurrence. We do not first measure a spatial distance and then explain motion by it. We read the change of the relation

under a chosen, continuous order of distinction. Only afterwards do we name that change four.

One condition is decisive: the intermediate readings must genuinely belong to the same directed, mutually compatible continuation. The digits .1 and .5 alone do not yield this particular trace. Number counts the read enactment. It does not generate it.

The Retrocausality of Measuring Position

Here the significance of retrocausality in Volume II comes into view.

We ordinarily picture the process as follows:

An observer occupies a starting position, passes through several intermediate positions and finally reaches a destination.

The sequence seems to bring the destination into being.

But such a description already assumes that positions succeed one another along an existing time axis.

The *Tractatus Principio* reads the relation differently.

Every Frozen Frame is a complete relational configuration.

The measured position .5 does not come into being only when an external time has played the preceding positions one after another. The measurement determines a complete relational configuration in which the previously open reading position appears as .5. From that determined configuration, the connection back to the initial reading .1 becomes readable as a coherent continuation. The present determination thus orders the relations we subsequently understand as the path travelled.

It is not merely the path that produces the measured reading position; rather, the determined reading position establishes which connection to it can be coherently read as a path.

That is the retrocausal reading.

It does not mean that an effect travels backwards through an existing time. It means that a determined relational configuration makes its own history readable as a connection between complete configurations. Our four transitions are not four instants that first had to elapse before .5 could exist. They are the directed continuation that we read from the measured configuration as belonging together. Another permissible continuation might connect the same endpoints and yet carry a different trace.

The measured result thus determines the conditions of coherence without uniquely prescribing every intermediate relation through its digit alone.

Observer and World Remain the Same Distinction

We therefore need neither an independent observer nor an independent world as two original things.

Self-measurement remains a reading of:

$$A|B$$

And because distinction refers to its own distinction, its operative origin remains:

$$\Delta := |(|)$$

The measured x is an open determination within that self-relation. The reading position .5 is its determined appearance under the

chosen fixation. The four transitions designate the directed continuation connecting both reading configurations in our example. Different modes of appearance can be gained from this one connection. From a geometrical perspective we read it as a positional difference; from a directed perspective as motion; through the coherent connection of complete Frozen Frames as temporal succession.

And from a numerical perspective we designate the four distinguishable transitions by the number four. These are not four different original processes.

They are different readings of one and the same self-reference.

The Original Measure

This changes the significance of measurement.

The conventional picture of space asks:

How far did the observer travel from position 1 to position 5?

Our investigation asks an earlier question:

What change in his reading-relation to the world has become recognisable in the determined relational configuration?

The first question already presupposes spatial distance.

The second begins with self-measurement.

Measure is initially the recognisable, traceable change of relation. Numerically counting its transitions is one possible reading of this measure. An ordered change can thus become readable from an unscaled self-relation before we attach an external unit of length

or time to it. We have thereby gained a first approach to tracing position and motion back to the same origin.

And the decisive consequence is:

We do not measure the motion of an object through a presupposed space. We measure the alteration of the reading under which a relational order appears as spatial and in motion. Time, then, is not the measure that first makes this change possible.

It is the experienced coherence of its directed connection.

PART III — TRACTATUS NOTATION AND SEQUENCE

CHAPTER 12

12. The Connection in Tractatus Notation

The sequence of signs that follows traces the argument of our derivation, not a temporal sequence in which difference came into being. We distinguish the signs of the *Tractatus* from their application to our table. The arrows indicate changes of reading or acts of determination, not the transport of an object through a presupposed time.

I. Origin: Difference and Self-Reference

A|B

Δ := |(|)

| denotes distinction, A|B its polar readability, and Δ its operative self-reference. These orders operate simultaneously and recursively, not as things generated one after another. A and B are not independently presupposed objects.

II. The Physical Reading: Observer | World

A|B —reading→ ¤|World

(¤|World)|¤

In Volume II, ¤ designates not a person standing outside the world but a point of fixation within the relation of perception. The second expression makes readable the return of measurement to the observer's own position. Observer and world remain the two poles of one distinction.

$0|_{-}\Delta \leftrightarrow 0|_{+}\Delta$

$0|¤|_{=}\Delta$

$0|(A|_{+}\Delta) \equiv 0|(B|_{-}\Delta)$

Contraction, expansion and their perceptual reading are different orientations of the same relation. Changing the reference point introduces no second origin.

III. Object and Change of Reference Level

Table —designation→ 1

1|.1

1|.5

1 is the visible mark subsequently assigned to a recognisable table relation, not a number from which the table comes into being. |. is the scale flip from Volume I. In our working reading, the characters following it designate fixations of the reading.

1|.1 | 1|.5 —contraction→ 1|.1|.5

Contraction is permissible only insofar as both views belong to the same recognisable relation. It is not a universal algebraic cancellation rule.

IV. Open Self-Measurement and Determinate Reading

1|.1|x

¤|World

1|.1|x —self-measurement→ 1|.1|.5

x stands for an open determination of reading, not a presupposed unknown spatial coordinate. .5 is the measured determination in the relevant perspective. What is measured is the change of the observer–world relation, not a distance within an already existing coordinate grid.

V. Frozen Frames Are Complete

|_| ≡ 0|₌Δ

¤: |1_|2 → |1_Δ2

These notations are from Volume II. Subscripted 1 and 2 in |1_|2 designate two complete relational configurations; they are not the table-one or reading positions .1 and .2.

In the words of our example:

complete frame with table-reading 1|.1

complete frame with table-reading 1|.5

The table-reading is merely one distinguishable reference within the complete configuration in each case. There is no motion inside either frame; only the coupling of complete configurations makes a change of position readable.

VI. Directed Continuation

1|.1|.5

—selected coherent continuation→

1|.1|.2|.3|.4|.5

.1 → .2

.2 → .3

.3 → .4

.4 → .5

These are four distinguished transitions under an unchanged reading rule. In the expansive perspective of Volume I we can read their recurrence as 1+1+1+1. The symbol 4 denotes this fourfold reading of an operation of difference. The number four was not its origin.

1 + 1 + 1 + 1 —numerical reading→ 4

The endpoints .1 and .5 do not uniquely dictate this intermediate sequence. The claimed four steps measure precisely this compatible, directed trace—not every possible path between the same endpoints, and not four presupposed metres or seconds.

VII. Coherence and Retrocausality

Volume II also formulates the coherence of the frame relation as:

$$|\Sigma = ((|_|_1|_|_2) \Leftrightarrow (|_|_2|_|_1))$$

The determined reading 1|.1|.5 allows us to read complete relational configurations compatible with it as its history. If the chosen four-step continuation is coherent, it becomes readable as a path from the result backwards. The result does not subsequently create past things or transmit a signal backwards through finished time. Present fixation determines the backward readability of a sequence of complete configurations.

1|.1|x —determination→ 1|.1|.5

1|.1|.5 —backward reading of the selected trace→ 1|.1|.2|.3|.4|.5

Thus the second arrow designates an examination or reading of coherence, not the compulsory reconstruction of a unique sequence from the digits .1 and .5.

VIII. Spatial Reading, Motion and Time

Spatial reading: 1|.1|.5

Directed reading of the trace: 1|.1|.2|.3|.4|.5

Measure of the trace's enactment: 1+1+1+1 → 4

Frozen-Frame coupling: ¤: |1_|2 → |1_Δ2

Temporal reading (Volume II): $\Delta t = (\Delta_2 |\text{–} \Delta_1)$

The spatial reading distinguishes fixations; the motion-reading orders their alteration; the temporal reading coherently binds complete relational configurations under the observer's perspective. They are different readings of self-reference, not three independently presupposed containers or dimensions. The number 4 is not already a value of Δt.

IX. The Complete Argument

A|B

Δ := |(|)

¤|World ; (¤|World)|¤

0|₋Δ ↔ 0|₊Δ ; 0|¤|₌Δ

Table ↦ 1

1|.1|x —self-measurement→ 1|.1|.5

|_| ≡ 0|₌Δ ; ¤: |1_|2 → |1_Δ2

1|.1|.5 —coherent backward reading→ 1|.1|.2|.3|.4|.5

1+1+1+1 —numerical reading→ 4

Our concluding figure is this: no number measures a movement independent of itself within a presupposed space. In the observer's self-measurement an open reading-relation becomes determined; from that result its compatible, directed continuation becomes coherently readable. Its repeated differences can appear

as number, its differences of fixation as space, and its frame-coupling as time.

The sequence of notation is now complete: the four transitions of our chosen trace are already determined under its reading rule. Chapter 13 does not ask once more how this determination is possible; it asks what appears as distance, motion, resistance or heat within the same relation under different physical rules of measurement.

CHAPTER 13

13. Physics as a Gradient Reading of Difference

13.1 The Unit of Measure as a Stabilised Relation of Comparison

Having developed in Chapter 12 the route from distinction to countable change, we now shift our question. In physics we must determine under which rule of comparison such a change becomes readable as distance, duration or some other measured quantity.

A metre is a stabilised spatial relation of comparison; a second is a stabilised temporal one. Neither is an additional origin of difference, and they are not freely interchangeable names for the same quantity. Each unit determines **what kind of relation** is being compared and how its recurrence is to be read.

We can employ units repeatedly because their determination remains stable. Apparatus makes the relation technically accessible; it does not first produce its distinguishability. This is the role of measure in our physics of gradients.

13.2 Every Physical Statement Has an Observer Reference

“The stone is three metres away” makes sense only within a particular reference configuration: away from what, under which spatial reading rule, and against which fixed comparison? A measured value does not name an attribute of the stone floating freely in space. It determines a relation. Even when we delegate measurement to an instrument, this reference does not disappear. The instrument records a distinction under its technical order of comparison, which can be read back into the observer–world relation.

Dependence on the observer in **determination** does not make measurement arbitrary. Different observers can relate their results when they preserve the relevant comparison rules and reference configurations. What they jointly establish is a relation that remains compatible on being read back, not a measure existing outside every relation.

13.3 What Becomes Measurable Between Complete Frames

A single Frozen Frame is complete. It contains neither intrinsic duration nor a distance travelled. To specify physical motion we therefore compare different complete relational configurations under a stable observer reading. The spatial rule of measure distinguishes the relation of position; the temporal rule distinguishes its directed, recognisable continuation. Only their determined connection can appear as velocity. Neither reading is an independent container within which the other takes place.

Nor does measuring mass, gravitation or temperature denote an additional fundamental substance. Each selects a different direction of comparison within the complete relational order. The measured quantities remain distinct even if the same difference is their origin.

13.4 The Table's Trace as a Transition to Physics

The table's trace from Chapter 12 has five reading positions and four transitions distinguished under the same rule. As a **count of transitions**, four is already determined. But we cannot simply turn it into four metres, four seconds or four joules; these require different, separately determined readings of measure.

Nor do the same endpoints compel the same intermediate sequence under every kind of change. Which relation is readable backwards under which rule belongs to the physical statement itself.

The question of this chapter is therefore: **How does the binding of a relation change when the observer determines another complete relational configuration?** We shall call its graded reading a gradient.

13.5 What Is a Gradient?

In conventional physics a gradient describes the spatial change of a quantity. That explanation is not yet fundamental enough for us, however, because it presupposes space. In the *Tractatus*, we begin by asking how a relation changes under a particular orientation.

Volume I introduces several modes of difference. Three matter especially here:

$0|_{+}\Delta$

$0|_{-}\Delta$

$0|_{=}\Delta$

They mean:

$|_{+}$ – expansive reading: opening or unfolding.

$|_{-}$ – contractive reading: binding or folding back.

$|_{=}$ – equilibrium reading: the settling of the relation.

Expansion and contraction are not two independent forces. They are the two fundamental directions under which the same operation of difference appears. Equilibrium denotes its corresponding stabilised relational configuration. A gradient in our investigation is therefore initially a directionally distinguishable change in a relation's binding or unfolding. Only a specific physical rule of measurement turns it into a gradient expressed, for example, in metres or seconds. Thus physics begins to emerge as a multitude of readings of one common fundamental trace.

13.6 Gravitation: The Gradient of Folding Back

Volume II, Chapter X, describes gravitation as a gradient of degrees of freedom.

Its fundamental relation is:

$$0|_{-}\Delta \leftrightarrow 0|_{+}\Delta$$

The sign ↔ makes the mutual relation of these two directed readings visible.

The contractive reading designates the binding of the relation; the expansive reading its opening. Volume II describes gravitation as the folding-back reading of this common operation. Under one fixation the relation appears as concentration, under another as unfolding. It remains the same original self-reference.

Another notation from Volume II is:

$$0|\Delta_g \equiv 0|(¤|_{-}\Delta|_{+}\Delta)$$

Here three signs require explanation:

¤ – the observer as relational fixation.

Δ_g – the relation of difference determined under the gravitational reading; g marks this particular physical reading.

(…) – the relation enclosed by the parentheses is considered as a whole.

The formula does not designate gravitation as an additional thing outside the self-relation. It describes it as a particular reading of the relation between contraction and expansion with reference to the observer. Consider again our table between .1 and .5.

The gravitational question is no longer: Which unknown force must move the table between two finished points?

It is: How does the binding of observed relational configurations change under the gravitational reading?

The answer may later have a numerical value. But that value adds a scale to a relation whose origin already lies in the folding back of difference. The gradient has thereby been approached relationally. No numerical gravitational strength has yet been determined by our fourfold trace alone.

13.7 Heat: Change at the Boundary of Perception

Consider the same table from another perceptual perspective. We touch it and can experience it as warm or cold. Ordinarily we would say that its surface has a temperature, which can be measured with a thermometer. But a thermometer, too, operates under a particular rule of comparison; the unit in which we express its result is itself a stabilised reading of measure. Volume II, Chapter XVIII, examines the skin as an original boundary of perception.

Its fundamental relation can be read as:

Inside | Skin | Outside

This does not describe three independently existing things. It describes a boundary relation within which inside and outside first appear as distinguishable sides. The observer experiences change at that boundary, which he can read as warmth or cold. Volume II, Chapter VIII, also explicitly traces heat back to an

appearance of the directed drift of difference. Thus the thermal reading returns to the same foundation.

The question is: How does the thermally perceived boundary relation differ between the configurations under examination?

Care is needed here. From the notation

1|.1|.2|.3|.4|.5

it does not follow that temperature rises by four degrees. The four transitions initially belong to our selected positional reading. A temperature difference arises only after we determine a thermal reading rule. Yet even that rule presupposes difference's original self-reference. Heat is not identical with spatial displacement; it is another physical reading of change. Its particular measuring rule still needs elaboration.

13.8 The Speed of Light: The Fundamental Reference for Spatial-Temporal Physics

The relation among different readings of measure becomes particularly significant in the case of the speed of light.

In established physics, c has a special status: the speed of light in vacuum is the fundamental reference linking spatial and temporal measurements. We ordinarily express it in metres per second:

m/s

Here:

m – metre, the spatial unit.

s – second, the temporal unit.

/ – the relational reading “per.”

But both units must themselves have come into being as relations of measure. We can therefore expose the underlying distinction:

Metre | Second

We have not yet performed division. We have first made explicit that measuring velocity relates two already distinguished readings of measure.

Division itself requires explanation. Volume I denotes its reading as:

$|\div$

It is the disentangling reading of difference. It determines a perspective in which the two related measurements are compared. Yet the light relation has a deeper meaning in the *Tractatus* than merely the connection between two units.

Volume II does not describe the observer as a point outside a finished world. The observer, denoted by ¤, is a fixation within his own distinction. His perception arises through the relation between the folding-back and unfolding directions:

$0|_{-}\Delta \leftrightarrow 0|_{+}\Delta$

The signs $|_{-}$ and $|_{+}$ denote contraction and expansion; ↔ their mutual relation. The observer's equilibrium reading is written:

$0|¤|_{=}\Delta$

¤ – observer as relational fixation, not an independent thing.

$|_{=}$ – the stabilised equilibrium reading.

0 – the potential reference.

Δ – the operative self-reference of difference.

From this relation emerges the spatial reading of what we call the sphere of perception. That sphere is not a presupposed three-dimensional container or an additional original dimension. It is the spatial appearance of the self-referential relation of perception. The light relation is the particular measurement relation in which this spatial appearance is fixed as a limiting relation and coupled with temporal readings.

Volume II, Chapter IX, formulates the corresponding speed-of-light reading as:

$$0|c \equiv 0|(\Delta\ |\div \Delta t)_{max}$$

The signs are:

0 – potential reference, not merely arithmetic zero.

| – distinction as relational positing.

c – the physical speed of light.

≡ – correspondence between relational readings.

Δ – operative self-reference of difference.

|÷ – disentangling or division reading.

Δt – temporal difference-reading of complete relational configurations.

max – the limiting reading described in Volume II.

(…) – the relation considered together.

Thus the formula does not derive the speed of light from two things already independent and named space and time. It reads c as a particular limiting or fixing relation under which spatial and temporal measurements can be coupled at all.

Nor is Δt an originally running time. Volume II describes the temporal difference as:

$$\Delta t = (\Delta_2 \,|_{-}\, \Delta_1)$$

Δ_1 and Δ_2 denote relations distinguished in two complete relational configurations. The digits are indices, not presupposed instants of time. Here $|_{-}$ denotes the contractive reading of difference.

Consequently, the speed of light is the fundamental reference for spatial-temporal measurement in physics. In our work-internal derivation it becomes recognisable as the spatial reading of the sphere of perception through the light relation. This does not mean that the sphere of perception is itself a light particle moving through a finished space. The measured speed of light is instead the scaled physical appearance of an invariant reference within that sphere. The speed of light does not generate the sphere of perception; it is the physical reference under which the sphere's spatial reading becomes measurable through the light relation.

The unit m/s can thus be traced back: metre and second are already stabilised spatial and temporal readings of measure. Their ratio is the public physical expression of a relation that does not first arise from the units. The concrete numerical value of this limiting reference does not follow from our table example alone; it is fixed and scaled within physical measurement practice.

13.9 Mass and Resistance: Bound Change

When we try to lift the table, we experience weight, physical effort and resistance. Conventionally we would say that the table possesses mass and that our body must exert a force. Volume II, Chapter XVIII, instead traces the experience to the observer's self-measurement in different complete relational configurations. The observer directs himself towards another configuration and experiences the change as bodily effort. Motion is not the migration of unchanging substance through empty space; it is read as the difference between complete relational configurations.

Mass appears, in this view, as a particular bound reading of the relation. The kilogram, too, is thus a later unit of comparison, not the original cause of the perceived resistance.

The connection becomes clear when we consider the two fundamental directions again:

$$0|_{-}\Delta \leftrightarrow 0|_{+}\Delta$$

In readings of mass and resistance, bound change is foremost. In the gravitational reading, by contrast, we examine the folding back and gradient of binding within the structure. Both readings return to the same operation of difference. That does not make them identical physical quantities. Each measuring rule determines which appearance becomes distinguishable.

13.10 Motion and Energy: The Difference Between Complete Frames

How does energy relate to our change of position?

We established that every Frozen Frame is complete:

$$|_| \equiv 0|_{=\Delta}$$

Volume II describes the coupling of two such configurations by:

$$¤: |1_|2 \rightarrow |1_\Delta 2$$

The notation requires explanation:

¤ – observer as relational fixation.

|1_|2 – coupling of two complete frames; here the digits are frame indices.

|1_Δ2 – the relation distinguished between them.

→ – a change of reading, not an external flow of time.

These frame indices must not be confused with the one of our table relation. No movement occurs within a single frame. Only by relating different complete configurations can the observer read their difference as movement. Their coherent continuation appears as time. The change so determined can be read under a temporal rule of measure as energy.

Volume II writes:

$$0|E \equiv 0|(\Delta\ |\div \Delta t)$$

Here E is the physical quantity energy.

0| – puts the following quantity into relation with potential.

Δ – operative self-reference of difference.

|÷ – disentangling reading.

Δt – temporal difference-reading.

≡ – connects the physical appearance with its relational description.

Energy is thus not an additional substance that sets difference in motion. It is a particular physical reading of change in difference. Nor is the joule an original building block of the structure of difference. It is the subsequently stabilised unit of a particular energy determination. Our four positional transitions from .1 to .5 are therefore not automatically four joules. That would require deriving the specific energy-measurement rule from the relation. The common fundamental trace explains why such readings can be related at all; it does not replace their particular physical determination.

13.11 Sound and Echo: Different Senses, One Table Relation

We can not only see the table but touch it or infer its presence and location acoustically from reflected sound. These perceptions differ markedly. A visible tabletop is not a sound echo; neither is the echo identical with the surface's resistance. Yet all three perceptions can refer to the same table.

How is that possible?

The observer does not merely distinguish his world. He also distinguishes his own readings of that world.

Volume II formulates this return as:

¤|World → (¤|World)|¤

The first expression designates the observer–world relation; in the second, that relation is itself referred back to the observer.

The reading becomes a subject of distinction in its own right.

The observer can experience his optical reading changing while other perceptions remain in relations compatible with it. Thus the recognisability of the table is not based on one sensory impression. It rests on the connection between different perceptions readable through self-reference. That is why we can continue using 1 for the recognisable table relation—not because the table was originally a one, but because we recognise it under different reading rules as a connected relational form.

Acoustic measurement needs a rule of its own. Volume II supplies the general basis of self-measurement; a complete quantitative derivation of acoustics has not yet been supplied by it.

13.12 The Common Fundamental Trace and Its Various Physical Gradients

We can now refer the different physical readings back to their shared starting point.

Our determined table relation is:

1|.1|.5

Under a directed reading rule one possible continuation is:

1|.1|.2|.3|.4|.5

Four distinguished transitions are read numerically as:

$$1 + 1 + 1 + 1 \rightarrow 4$$

This fourfold trace is already a determinate count of four transitions under the selected stable reading rule. Its validity comes from the backward readability of self-measurement, not from a second certification granted from outside. Four counted transitions are not yet four equal metres or four equal seconds. Physical statements of that kind designate different, explicitly defined readings of measure.

What appears as a physical quantity depends on the rule of reading.

Under the spatial reading, a change of position appears.

Under the temporal reading, a coherent sequence of complete configurations appears. Under the energy reading, change in difference appears in relation to temporal difference. Under the gravitational reading, the alteration of binding and folding back appears. Under the thermal reading, a thermally distinguishable change at a boundary appears. Under the optical reading, a change in a visible relation appears. The light relation also has a special role as the fundamental physical reference for spatial-temporal measurement. Under the mass and resistance reading, bound self-measurement appears as bodily effort.

These are not mutually independent original realities. They are different physical readings of one common relational origin.

But the converse is just as important:

Common origin does not make the different physical readings identical. Four positional transitions are not automatically four

metres, four seconds, four kelvin or four joules. Such an equation would merely introduce a fresh confusion of readings. Every physical appearance requires its particular rule of comparison. Its numerical value results from that rule. The unit names the stabilised kind of comparison. Both remain traceable to the original distinction.

13.13 The Retrocausality of a Physical Measured Value

A measured value denotes a determined relational configuration. Its numerical sign alone does not decide which intermediate readings belong to its history. The coherence explained in Part III also holds for physical measurements: from the determined result, those complete configurations are read as connected that are compatible with the selected measuring rule.

This is the retrocausal reading of Volume II, not the transmission of signals against an external flow of time. For physics it has a concrete consequence: a measured temperature, position or energy cannot be separated from the relation under which that quantity was determined. Whoever adopts a different reading rule must work out the corresponding connection of relational configurations again.

13.14 Physics Reads Difference

In Volume II, gravitation, heat, light, mass and energy can be traced back to different operational and measuring readings of the same self-reference. They are not thereby the same physical quantity: each has its own conditions of comparability. The light relation occupies a particular role as reference for the spatial-temporal measurement of the sphere of perception.

The chapter has thus answered **what** physical quantities can mean within a structure of difference. What remains to be explained is **why** an observer can bring forth a stable reading rule across multiple changes in the first place. Only after addressing that question can we develop a constructive model of space, time and perception from the fundamental trace.

CHAPTER 14

14. From the Fundamental Trace to a Stable Reading of the World

14.1 What the Model Still Has to Explain

Chapter 13 treated physical appearances as different readings of the structure of difference. One assumption remained open: how can the observer connect his various perceptions and complete relational configurations under a lasting rule at all?

We cannot simply delegate the answer to another instance, such as a ready-made mind possessing its rules independently of the world. That would separate observer and reality again. We seek a rule of reading whose stability arises from the same self-reference as the world it reads.

14.2 The Inference Backwards: Frame and Observer Have the Same Structure

Our extended representation of a complete frame is:

Δ|Δ → Δ|_|Δ

The two Δ are not two things. Δ denotes the self-distinction of difference; the notation illustrates its mutual folding back. The enclosed |_| stands for the complete self-relation. The arrow

denotes the unfolding of a reading, not an event in presupposed time. The whole line is our refined working notation. For the closure of the Frozen Frame, Volume II expressly uses:

$$|_| \equiv 0|_{=}\Delta$$

Now consider the observer relation from Volume II:

¤|World

(¤|World)|¤

¤ designates the observer as a fixation of a relation. The first expression distinguishes observer and world; the second refers this distinction back to the observer's position.

The decisive connection lies in the structural correspondence: **The complete self-relation and the observer's self-measurement repeat the same arrangement of return.** We do not equate the formulas sign by sign. Their equivalence concerns the structure of the operation: a relation is referred to again, and its order of distinction remains readable.

The rule of reading therefore need not be invented by an observer standing outside the relation. The observer is himself a stable mode of appearance of the very operation he reads.

14.3 How the Rule Stabilises Itself

Volume IV describes stability as an invariant self-relation. A recurring order of difference is represented, for example, by:

O Δ O

Here O stands for a particular order of difference, and Δ for its renewed self-distinction. The formula describes the case in which the order preserves its form through this distinction. Not every recurrence meets this condition: an order may change or alternate among different forms.

This allows us to specify the observer's reading. When the relation ¤|World is distinguished anew, nothing outside that relation must decide what counts as recurrence. The ability to read an order again as the same belongs to the stabilised self-reference of observation.

Initially this is a **rule of recognisability**, not a claim that distances are equal. It explains why different sensory readings can concern the same table although sight, echo and touch are not identical.

The further question of quantitative measure is: under what conditions does not only the table remain recognisable, but also the manner of its directed distinction become comparable from step to step?

14.4 Self-Referential Measurement at the Table

The table relation continues to be denoted by 1. That one stands for a recognisable form, not an original numerical magnitude. .1 and .5 are distinct reading fixations; the dot denotes the scale flip from Volume I.

1|.1|x → 1|.1|.5

x denotes the open other reading position. The result .5 by itself determines no intermediate sequence. If we select a continuation that can be read consistently throughout, we obtain:

1|.1|.2|.3|.4|.5

Under this selected rule four transitions can be distinguished. Their numerical reading is:

1+1+1+1 → 4

The four ones here denote four accomplished distinctions. The 1 at the start of 1|.1, by contrast, is the stable mark for the table.

Under the maintained rule, the four transitions are already determined as four differences. Their backward readability belongs to the observer's self-measurement and requires no additional external instance to grant permission to count them. Nevertheless, four counted transitions are not yet four equally long stretches or four equal durations. No unit grounded outside self-reference is required merely to distinguish a continuation. An expression in metres or seconds names the corresponding stabilised comparative reading, not some later justification of self-distinction.

14.5 Expansion and Contraction in Numerical Reading

The two fundamental directions in Volume I can be read side by side: $|_{+}\Delta$ denotes expansion, $|_{-}\Delta$ contraction. Repeated steps of distinction appear in arithmetic reading as $+1$ and -1.

Expansion – $|_{+}\Delta$

1 2 3 4 5

1 + 1 + 1 + 1 + 1 + ...

Contraction – $|_{-}\Delta$

5 4 3 2 1

... - 1 - 1 - 1 - 1 - 1

The **upper digits** mark five readable positions. Between five positions are **four transitions**; the five visible ones in the open notation must therefore not be counted as five steps of our four-transition trace. The string of ones illustrates repeated distinction: in expansion the order is read in the $+1$ direction, in contraction in the opposite -1 direction.

Neither series has a necessary starting or ending point. In particular, contraction does not begin with a presupposed object called “five.” Five is just a visible reading mark in an open sequence. We obtain not two independent operations but two directional readings of one operation. Reversing the numerical reading does not mean that time flows backwards.

For the table, the same opposition is visible:

$1|.1 \rightarrow 1|.2 \rightarrow 1|.3 \rightarrow 1|.4 \rightarrow 1|.5$

1|.5 → 1|.4 → 1|.3 → 1|.2 → 1|.1

Both sequences concern the same recognisable table relation. They show opposite directions of reading, not paths of equal length through an existing space.

14.6 How the Sphere of Perception Appears Spatially

Volume II uses the following relation for observer fixation:

$0|_{-}\Delta \leftrightarrow 0|_{+}\Delta$

$0|\text{¤}|_{=}\Delta$

The first line displays the mutual directions of folding back and opening. The second denotes the equilibrium reading of the observer relation. The signs were explained in Chapter 13. What matters here is **what their common structure makes possible for spatial perception**.

When the observer stably recognises changes in his relations, *here* and *there*, near and far, foreground and background become readable as spatial distinctions. The depth of that perception is not proof of an independent third fundamental dimension. In our framework the fundamental dimensionality remains twofold; depth arises as a perspective of self-referential reading.

The plus-one chain is not a spatial axis. It merely illustrates how the same directed distinction is read in increasingly differentiated form under a numerical rule. Only the observer fixation and corresponding geometrical reading make a spatial appearance possible from it.

14.7 How Motion and Time Appear as Other Readings

Time, too, requires no second origin. A complete Frozen Frame contains neither elapsed duration nor travelled distance. Volume II represents the coupling of two complete relational configurations by:

¤: |1_|2 → |1_Δ2

Here 1 and 2 are frame indices, not the table's mark or its reading positions. The formula designates the observer's reading of difference between two complete frames.

Their differences of fixation can appear spatially; their directed relation can appear as motion; the coherence of this relation can appear as time. Volume II already expresses temporal difference as $\Delta t = (\Delta_2 \,|_{-}\, \Delta_1)$.

Backward readability is decisive: the determined result limits the possible coherent histories. It does not create earlier frames within a time running backwards. Once again it is the stable rule of reading that operates, not an additional chronology outside the relational configurations.

14.8 What the Light Relation and Our Senses Contribute

The speed of light has a special physical reference role. As Chapter 13.8 explained, through the light relation the spatial reading of the sphere of perception becomes comparable with temporal measurement. Metres per second already expresses two derived readings of measure, not their origin. Optical, acoustic and tactile changes associated with the table can be related to one recognisable fundamental relation. This reveals the self-reference of the observer's rule; it does not mean that all three senses deliver the same information or that their particular physical procedures of measurement are already identical.

We can now describe **why** different appearances can jointly be read as one world. Their numerical calculation still requires the specific physical rule of reading in each case.

14.9 Determinate Self-Measurement Needs No Second Certification

We have deliberately not presupposed an instance of measurement independent of the relation, which would first have to allow the observer to make his own distinctions. Such a demand would once again move the explanation outside the very relation whose self-reference we have just derived.

The mirroring of a complete relational configuration and the observer's self-measurement possess the same structure of return. Under a stable reading rule, the observer can recognise his differences as a connected continuation and read them backwards from the determined result into his own relational

order. This is not a retrospective confirmation granted by something foreign; it is the act of determination itself.

For our table's trace:

1|.1 → 1|.2 → 1|.3 → 1|.4 → 1|.5

1+1+1+1 → 4

We have five distinguishable positions and four transitions. Four is determined as the count of those transitions under the stated rule. No further proof is needed to permit a recurrence so determined to be counted. The ones denote repeated application of the chosen distinction rule, not four originally present, independently calibrated lengths.

To express these transitions in metres, we add a spatial comparative reading; to express them temporally, we use a stabilised recurrence as the measure of time. We thereby alter the kind of reading, not create an independent instance whose permission first validates the original measurement. The same notation of ones must not be confused with an assumed equality of physical distances or durations. Their connection lies in the preserved rule and backward readability within the same observer–world relation.

Unambiguity lies in determining the relation, not in a subsequent instrument and not in a permission granted from outside to read it as a measure.

We have thus returned to the starting point of this chapter. The stable reading of the world arises from the self-reference of difference. Space, motion and time appear as different, mutually compatible scalings of this self-measurement. The observer does

not stand outside the order he measures; his measurement is itself a mode of appearance of that order's return.

CHAPTER 15

15. Archibald and the Error of the Inner World

15.1 The Surface of Explanation

Archibald illustrates the shift once again. He believed he had discovered a two-dimensional planet, failing to notice that his own apparently three-dimensional world was depicted on a two-dimensional surface. His error lay in taking a particular spatial reading for the original constitution of reality.

A similar reversal occurs when we try to explain perception through eyes, skin, nerves and brain. We examine the observer, discover biological structures and then take them as the ground of the very observer under whose perception they first became distinguishable. Yet the brain, too, is something we distinguish under a particular rule of observation. We end up explaining observation through one of its own appearances.

15.2 The Table Sawed Open

Our table makes the same point. Initially we see its surface. If we saw it apart to uncover its supposed interior, a new surface appears. We recognise fibres and other structures which, under greater magnification, unfold into further differences. The same happens when we examine the body: skin, muscles, bones, brain, nerve cells. We certainly acquire new knowledge. But none of these readings leaves the distinction through which it appears at all.

Every supposedly uncovered interior becomes a surface once more under another distinction.

15.3 The Visible Signal Chain

A conventional biological explanation of touch begins with an external stimulus: it alters the skin, producing an electrical signal that travels along nerves to the brain.

This directed sequence is measurable.

But its measurability does not yet answer where the observer relation comes from within which skin, brain and signal are distinguishable. Volume II begins with the skin as a boundary of self-measurement. The observer distinguishes himself from his world at that boundary.

Our working notation is:

¤ | Skin | World

Here ¤ marks the observer fixation. **The poles of the distinction are `¤` and `World`; `Skin` denotes their bodily read**

boundary, not a third independent pole. Nor are the two poles presupposed as independently existing things.

The observer does not originally receive a message from an outside world already determined independently of him.

He distinguishes himself at his own boundary.

What appears under a neurophysiological measurement rule as an electrical signal chain is already a particular temporal reading of this self-distinction.

15.4 Two Directions, One Relation

Imagine a wave. We follow its visible surface and read a propagation to the right. Yet the visible direction of motion need not describe the entire underlying operation. For our analogy we therefore consider an opposing movement back beneath the surface.

The two directions illustrate two readings of the same relation.

Volume II writes:

$$0|_{-}\Delta \leftrightarrow 0|_{+}\Delta$$

Here:

- $|_{+}\Delta$ – the expansive, outward-directed reading of difference.
- $|_{-}\Delta$ – the contractive folding back of difference.
- $\leftrightarrow$ – the mutual dependence of both directions.

Under our temporal observation, the electrical signal chain from skin to brain appears as an expansive reading.

We see a sequence of electrical registrations.

What this reading leaves out is the folding back through which the sequence remains determined as part of the same self-relation. The minus-reading is not therefore a second hidden electrical signal that must anatomically travel in the opposite direction. It is the closure of the structure of difference, referred back to the observer.

Negative folding back conditions positive reading-out.

They are not causes occurring one after another but simultaneously operative reading directions of the same operation.

15.5 The Circle and Its Cut

We have returned to the beginning of our investigation.

Difference:

Its polar reading:

A|B

Its self-reference:

Δ := |(|)

What we have described as perception, electrical signal, warmth or motion returns to the same self-distinction. This self-distinction is circular: it refers back to the relation from which its own distinction arises.

Volume I illustrates this geometrically in its diagram of the circle. The 0 appears as a closed circle. The 1 is not entered as a counted thing but as a **stroke or radius** cutting the circle, making a particular direction readable within its closure. Mirroring this stroke yields the diameter-reading of 2. Numbers thus appear as geometrical positions of continuing distinction, not as finished building blocks.

The **cutting one** plays a different role here from two other uses of one. The table-1 denotes a recognisable relation; the operational-1 in 1+1+... denotes a distinguished step. The cutting-1, by contrast, illustrates how difference appears as a stroke in potential read geometrically as a circle. We use the same digit under three different reading rules, not as three original units.

We do not begin with a ready-made circle in space. The circle is the **geometrical reading** of closed self-reference; the stroke is the geometrical reading of the cut |. Only within this relation does a directed orientation arise.

We can express the connection as:

Closed self-relation | Cut | Directed unfolding | Folding back

This is an illustrative working reading, not a chronological sequence of separate events. The cut does not produce folding back afterwards; folding back already belongs to the completeness of the relation within which directed unfolding becomes determinable.

We have previously represented this self-relation as:

Δ|Δ → Δ|_|Δ

The two Δ are not independent things.

They denote the reciprocal return of difference.

The structure closes upon itself. The cut makes a particular unfolding of that closure readable.

This is the geometrical meaning of our circle.

We can follow one direction without claiming that the whole relation consists only of that direction.

The plus-reading unfolds.

The minus-reading folds back.

And observer fixation is the self-relation under which their common order appears as perception.

15.6 Why the World Acts Back Upon Us

We can now understand why we experience warmth, pressure and other effects of our world.

We distinguish ourselves in relation to our world.

That distinction opens an expansive reading under which an outward appearance becomes determinable.

Yet the same relation is folded back upon the observer.

The world is not an entirely independent pole that must first be connected to an equally independent interior through an additional chain of signals.

It is the opposing pole of the same self-distinction.

Volume II denotes the observer fixation between expansion and contraction by:

$$0|¤|_{=}\Delta$$

Here $|_{=}\Delta$ denotes the equilibrium reading.

Perception is the determined appearance under which the oppositely directed readings become operative within one observer relation.

We experience a change in this boundary relation as heat.

Under a different reading rule we experience it as pressure or resistance. Under a neurophysiological rule its directed continuation appears as a cascade of electrical signals.

These appearances differ.

But they require no different original causes.

The contractive return closes the observer's self-distinction. Expansive reading-out lets its change appear as a phenomenon of the world. The seemingly separate interaction between inside and outside is thus traced back to one relation returning into itself.

15.7 We Have Been Speaking About the Same Difference All Along

Archibald saw a two-dimensional surface and believed he had found an alien world with fewer dimensions. We observe electrical signals and believe we have discovered the original mechanism of perception. In both cases we mistake one direction of appearance for the whole relational operation. Yet our investigation has continually brought us back to the same starting point.

We considered difference.

We read it as number.

As spatial orientation.

As temporal continuation.

As motion, light, gravitation and heat.

As skin, brain and electrical signal.

Under none of these readings did we need a new original thing. We examined only how difference distinguishes itself and how that self-distinction appears under various rules. The circle makes the return upon itself geometrically comprehensible.

The cut makes its directed unfolding readable.

Contractive folding back closes the order.

And the observer appears as a stable self-reading of the connection. We see expansion and regard it as the cause, when it is a direction of appearance of a self-relation closed within itself.

That is Archibald's real error—and ours.

We believe we can explain experience through objects that appear within experience. Yet the original condition of these appearances is not another thing hidden beyond the last surface. It is difference referring to itself.

We have returned to |.

CHAPTER 16

16. The Gradient: A Relation Read Back to the Observer

16.1 Three Metres from Whom?

What does it mean to say that a stone is three metres away? Initially the statement denotes a spatial relation that we distinguish between observer and stone under a particular rule of measurement. Three metres is not an attribute attached to the stone independently of this relation.

It denotes a scaled configuration of difference.

This also clarifies the meaning of gradient. A gradient is not another thing acting between two objects. It describes how a relation changes by degrees from the chosen observer reference.

A gradient is a relational statement.

When we speak of a declining gradient, we do not mean that an invisible substance in space becomes weaker. We mean that the binding or change of the relation appears in graded form along a particular direction of reading. The gradient belongs to the reading. It does not stand outside the relation to generate it.

16.2 Scaling Difference

We previously considered different reading positions at our table. We can perform the same investigation with a stone.

We denote its recognisable relational form by 1.

Two reading positions are:

1|.1

1|.5

Between them we can distinguish a directed sequence:

1|.1 → 1|.2 → 1|.3 → 1|.4 → 1|.5

This contains five positions and four transitions.

It does not presuppose that the transitions are equal in size or that every position corresponds to a particular metre value. Scaling arises only under the reading rule with which we compare those differences. We can distinguish a relation coarsely or finely, introduce additional intermediate configurations or capture several transitions in a contracted reading. But that does not make every arbitrary subdivision a valid measurement.

Correct scaling is that under which the distinguished intermediate configurations remain compatible with the complete relational order and coherently readable backwards from the determined result.

The result 1|.5 limits which earlier configurations can count as its connected history.

A scaling that violates this belonging-together does not describe the same coherent continuation. The rule of measurement thus has a concrete task: to distinguish gradations in such a way that their return to the preserved fundamental relation remains possible.

16.3 Why the Stone Appears Heavy

If we try to move the stone, we would ordinarily say it has mass and therefore requires a force to set it moving. Within our derivation, however, the explanation begins with the alteration of a complete relational configuration. The observer determines another position within the structure. He cannot alter only the stone's spatial reading position while ignoring all other relations. The stone stands in relation to the ground, the observer and other bindings within the entire structure.

The desired configuration must form a coherent complete configuration under these relations.

Heaviness is here the gradient reading of the bindings that must be taken into account in this self-measurement.

The object does not originally carry an independent property called heaviness. We experience a graded difficulty in determining another configuration while preserving backward readability. What appears as bound order under the mass reading is experienced as resistance to change under the motion reading. The physical quantities remain different, but they must not be presupposed independently of the observer reference.

16.4 The Regress of Force

When we push against the stone, classical physics describes a corresponding reaction force. Investigating the interaction more closely leads to electromagnetic relations. Further investigation opens up additional physical structures and descriptions.

We can thereby calculate relations with increasing precision.

But this need not answer the original question.

We have introduced another distinction.

Just as with the sawed-open table.

We open a surface and find another.

We examine that surface and find further differences. If we declare each appearance the actual cause of its predecessor, we enter a regress. Changing the word *force* to *field*, *charge* or *interaction* does not remove the problem.

Those terms, too, denote particular physical readings.

Our gradient must not become the next hidden mechanism.

It denotes nothing beyond the graded relation the observer distinguishes under his rule of measurement.

The question is not what invisible something really pushes the stone. It is what alteration of the complete relational order can be determined from the observer and read backwards as a connected continuation.

16.5 Energy and Heat as Different Gradient Readings

We can now situate energy and heat.

We move a stone across the ground.

Under a spatial reading, its position appears changed.

Under a mechanical reading, we determine a resistance and work performed. Under a thermal reading, we register a warming of the boundary relations involved.

These appearances are not identical.

But they are different evaluations of change in the same structure.

Volume II writes the energy reading as:

0|E ≡ 0|(Δ |÷ Δt)

Energy is thus a measurement reading of change in difference under its temporal differentiation, not an original substance that must be added to explain difference.

Heat is similar.

When we move the stone and its boundary relation to the ground changes, this change may appear as warming under a thermal rule of measurement. Nor does heat possess a given value independently of every reading. Its determination requires a standard and a reference against which the relevant change becomes comparable. This does not mean that spatial, mechanical and thermal quantities can be translated into one another arbitrarily.

Each has its own reading rule.

What they share is not the unit of measurement but the self-reference of the order of difference whose change they scale in different ways.

16.6 Backward Readability Decides

We now arrive at the connection between gradient, Frozen Frame and observer.

A complete Frozen Frame has no internal duration.

The observer distinguishes another complete relational configuration and reads its relation to his previous position as change. From the determined configuration that history becomes readable under which it appears as a connected continuation.

This relation can be scaled in different ways.

We can distinguish larger and smaller steps.

We can determine a directed spatial distance.

We can evaluate its change temporally, mechanically or thermally. But the chosen scaling must not destroy the belonging-together of the complete relational configurations.

Backward readability is therefore the criterion for valid scaling within the same self-relation.

It means that the gradations can be referred back from the reached configuration to their own order of difference. This does not mean that only one scaling is possible. Different scales can validly describe the same relation. What matters is that

comparison rules are not changed arbitrarily and that their results remain compatible. This is the boundary between an arbitrarily drawn intermediate sequence and a justified measurement.

A gradient is thus the graded reading of a relation to the observer.

A measure is the stabilised scaling of that relation.

And the correct scaling is one that remains coherently readable backwards within the complete self-relation.

Accordingly, mass, force and energy need not be installed as original causes of change. They can be understood as different physical readings of bindings and changes that the observer determines within the whole structure.

We have found no further hidden cause.

We have specified the conditions under which difference appears as a measurable physical relation.

CHAPTER 17

17. Light: The Limit of Self-Measurement

17.1 Archibald and Outsourced Perception

Through his telescope Archibald discovers a planet that appears to him as two-dimensional. The apparatus enables him to make a distinction inaccessible under his previous perceptual reading. He has not created an observer outside himself. He has technically extended the boundary of his self-measurement.

The telescope changes what he can distinguish.

When Archibald subsequently flies towards the planet in his rocket, he extends another reading: the alteration of his own position within the structure. The rocket couples his motion-related self-measurement to a machine that makes other relational configurations accessible. Both devices change the scaling of his measurement, not its origin. The sphere of perception is therefore not an immutable spatial container surrounding Archibald. It is the geometrical reading of the current boundary of his self-measurement.

Schematically the relation is ¤|World. Telescope and rocket are not third original poles but differently outsourced boundaries within that relation.

17.2 Two Geometries, One Measurement

To measure velocity, Archibald uses the familiar notation:

m/s

Metres per second.

Here we interweave two different geometrical measurement readings of the same difference. The metre designates the expansive spatial reading. When Archibald says an object is three metres away, he determines his relation to it under a spatial rule of measurement. Three metres is not an original property of the object; it is a particular scaling of its relation to the observer. The second, by contrast, denotes a temporal reading of comparison. It does not unfold spatial distance outwards; it determines the recurrence of an order of difference as comparable continuation.

Such recurrence can be read geometrically as a circuit. An ordinary clock illustrates it: a hand goes around a circle, whose revolution we divide into sixty second-positions. Spatial reading appears directed, while temporal reading appears as a cyclically stabilised comparative order.

We do not compare two independent things called space and time. We interweave two geometrical readings of the same self-distinction.

17.3 The Hand and the Caesium Atom

A modern clock need not use a hand to determine a second. It can employ a particular atomic transition frequency as its comparative relation. What has fundamentally changed?

We have not left the recurring comparative order behind; we have altered its technical realisation. With a clock hand we read a position within a cyclic revolution. With an atomic clock we count a defined number of periodic processes to realise the unit of time. The physical mechanisms and attainable precision differ. A caesium atom is not a tiny clock hand. Yet the fundamental measurement task is the same: we distinguish a recurrence and relate another alteration to that comparable order.

An atomic clock can realise our comparative rule far more precisely and stably. It does not thereby create the possibility of comparison in the first place.

Even atomic recurrence can be determined as recurring identically only under a particular measuring rule.

17.4 Unambiguity Belongs to Determination

We must distinguish determinacy from measurement accuracy. Determinacy means that we have fixed which relation is to be distinguished under which rule. Accuracy concerns how reliably the instrument realises this determination. A finer dial division, another decimal place or a more stable atomic clock does not create an originally more precise time. It refines our reading of a fixed relation of comparison. The sixty divisions of a clock revolution are a particular, historically established scaling; they do not mean that difference itself consists of sixty parts.

Scaling can refine our reading. It does not first create the unambiguity of the relation being read.

17.5 Why Velocity Is a Reading of a Ratio

Archibald travels in his rocket to another relational configuration. Under a spatial reading, this change appears as a distance travelled; under a cyclically stabilised temporal reading, its continuation appears as duration. Comparing the two yields velocity. The ratio m/s thus designates the coupling of two scalings. That coupling must remain valid within the same observer relation.

If Archibald changes the spatial unit, the numerical value must be convertible accordingly. If he replaces a clock hand with a more precise timekeeper, this alone must not create a different relation of motion. The rocket allows a different coupling of movement-related self-measurement than his body without the apparatus. That is more than a change of unit, but this technically

mediated alteration, too, must remain readable backwards as a relation between complete relational configurations.

Velocity is the read-out relation between a directed spatial change of difference and its temporally determined continuation.

17.6 Why the Light Relation Recurs Identically

Volume II writes:

$$0|c \equiv 0|(\Delta\,|\div \Delta t)_{max}$$

Δ designates operative difference, Δt its temporal difference-reading and |÷ the relational disentangling reading. The index max marks a distinguished limiting form of the coupling.

From an external perspective we may call this repeatedly identical light relation a natural constant. In our derivation, however, its constancy does not designate a property posited independently of measurement. We ask how a self-referential measurement relation preserves the same limiting form under different permissible readings.

Recurring equality is the stable self-relation of measurement, not another original thing placed beside difference.

This distinguishes its external designation from our relational question. The *Tractatus* does not take invariance as a finished answer but as the expression of a return whose conditions of emergence must be derived.

17.7 The Number Is the Read-Out Position

In today's International System of Units, the fixed numerical value is:

299 792 458 m/s

Metre and second are themselves readings of measure. The second is realised through a defined atomic frequency, and since 1983 the metre has been defined using the exactly fixed numerical value of the speed of light. The decimal sequence is therefore part of a chosen and stabilised order of measurement. We do not measure some original numerical substance of light. Far from removing the subject of our relational approach, this shows how a repeatedly determined relation itself becomes the basis of the unit used for further measurements.

The stipulation must not be confused with the physical light relation. It is the way we express that relation numerically under a particular measuring rule.

17.8 The Actual Task of Our Calculation of Light

Our starting question is therefore not why a supposedly independent constant happens to carry a particular decimal number. We must explain how the expansive spatial and cyclically determined temporal readings of the same self-reference remain mutually compatible when apparatus coupling changes. What physics reads as an invariant limiting speed, we examine as the limiting reading of a self-measurement recognising its own relation across different geometrical orders of measure.

This establishes the starting point for our geometry of numbers. In the next chapter we investigate not three independently existing numbers but the mutual relation among the geometrical readings represented in Volume II through the light-number.

CHAPTER 18

18. The Geometry of the Light Number: Mirroring, Breakpoint and Self-Reference

18.1 The Question of the Number's Geometry

Chapter 17 showed what we interweave in measuring velocity: an expansive spatial relation and a cyclically determined temporal order of comparison.

Both are different readings of the same self-reference of difference. Their distinguished limiting form appears under the light relation:

$$0|c \equiv 0|(\Delta\,|\div \Delta t)_{max}$$

From this relation we can turn to the numerical reading in Volume II. In the chosen SI order of measurement, the speed of light is expressed as:

299 792 458 m/s

Volume II divides this numerical expression into 299 | 792 | 458 and reads the results 2|0 – 9 – 8.

An isolated interpretation of the digits, however, risks treating pieces of a measured appearance as independent causes once

more. We must first explain why the numerical figures in Volume I acquire meaning only within one geometry.

18.2 One Is Zero from Another Perspective

Volume I represents zero geometrically as a circle. The circle denotes a closed relation returning to itself, without a distinguished beginning or end in that reading. One appears as a line cutting the circle. Yet the line must not be introduced as something alien, breaking open a finished closure from outside. We would then have to explain where that alien line came from, opening yet another surface.

One is zero under another geometrical reading.

Seen from the front, the circle displays its roundness. As a conceptual side projection, the same closed form appears as a line. We do not presuppose an original three-dimensional space here; the comparison merely illustrates the different readability of one relation. Apparent linearity does not abolish closure. The line is already self-referential because it is a reading of the same circular relation.

One does not inaugurate a self-reference that was previously absent. It is its directed appearance.

This is exactly the structure of A|B: A cannot be determined without B, nor B without A. Likewise, zero as circle cannot be explained without one as its directed reading. And one makes sense only as another reading of that closure.

We write:

0|1

The further sequence

0|1|2|3|4|5|...

is neither a series of independently created things nor a process occurring in an existing time. It is the recursive differentiation of third-order difference. Each number distinguishes the existing relation again and displays its cyclic recurrence under another geometrical position.

Only the observer reads this recurring order as a temporally directed continuation under stable self-measurement.

Time does not produce the numerical sequence. Its directed reading presupposes a recognisable order of difference.

We can divide the same basic relation differently:

0|1|1 → 0|2

On the left, the recurrence of two one-readings remains explicitly divided; on the right it is condensed into a two-reading under a particular rule. The internal division of the representation differs, but the common original relation remains readable backwards under the appropriate rule.

Thus the double readability encountered in Chapter 17—directed expansion and cyclic recurrence—is already present in 0|1. They need not first be linked afterwards through the physical notation m/s.

18.3 Two: The Mirroring of What Is Already Closed

Volume I describes two as the mirroring of one: the geometrical reading of a radius becomes a diameter. This must not suggest that one needs a second half before it can be complete. As another reading of zero, it was already self-referential.

Two makes the opposing relation explicitly readable as polarity.

A|B does not designate a connection between originally independent objects. The poles are determined solely through the distinction they jointly sustain.

The same holds for observer and world. The observer does not stand before a finished sphere of perception already read independently of him. His observer position is determined within self-measurement in relation to its opposing pole.

This supplies the connection in the reading 2|0: two makes mirroring visible, zero makes its closed return visible. These meanings are not things assembled retrospectively.

18.4 Three and the Breakpoint to Four

With three, Volume I introduces the triangle. An equilateral triangle has three interior angles of sixty degrees:

$60° + 60° + 60° = 180° = \pi$ rad

Three here denotes a closed relation among relations.

Four changes the geometrical order. A square has four ninety-degree angles:

$4 \times 90° = 360° = 2\pi$ rad

A diagonal divides it into two right-angled triangles. For each:

$45° + 45° + 90° = 180° = \pi$ rad

The new figure thus contains two triangular orders, whose angle sums add to 2π. At the same time the distribution of angles in each triangle has changed from that of the equilateral three-geometry:

60° | 60° | 60° as against 45° | 45° | 90°

The triangular relation remains distinguishable but is referred back to itself under a new division.

The shift of angle sums from π to 2π illustrates half and full circular angles. It does not mean that a square actually travels around a circle, nor is it by itself a derivation of π. At this breakpoint from three to four, Volume I situates the further relation between division and the closure of the circle. Four therefore appears not merely as the fourth counting step but as another level of geometrical return.

18.5 Eight: Two Fourfold Orders in Relation

Volume I describes eight as an inner return to symmetry. Its fourfold structure is mirrored.

Arithmetically, 8 = 4 + 4. For our geometrical use, 4|4 is more revealing.

The two fourfold orders are not independently given figures. They are two readings of the breakpoint at which the existing geometrical relation is distinguished anew under a further order.

In Chapter 17 we encountered a corresponding duality:

Metre | Second

Spatial measurement is expansive and directed; temporal measurement is cyclically scaled and read as directed continuation. Both are bound to the same self-relation.

In our application this double geometrical relation is read as 4|4 and hence as eight.

Eight here does not denote two alien geometries but the mutual readability of two fourfold orders of the same self-reference.

18.6 Two Already Operates Within Eight

What allows the two fourfold orders to become two distinguishable readings at all? Their polar relation. And what keeps them readings of the same order? Their mutual mirroring.

Two does not therefore stand as an isolated number beside eight. **It designates the mirror-relation in which eight first becomes readable as 4|4.**

Conversely, eight is a particular geometrical expression of the polarity already determined by two. Without two, the fourfold orders would appear side by side as unrelated magnitudes. Without eight, two would remain a general mirroring whose specific spatial-temporal reading had not been shown. Without

zero, the closed return making both readings determinable as the same self-relation would be missing. These are not separate numerical causes in succession. The numbers support one another as readings of a common geometry.

18.7 Nine: The Limit of Determinate Reading-Out

Volume I calls nine the keystone of single-digit numerical order. With 9 + 1 → 10, the positional notation changes level.

This does not mean that difference itself ends. The previous scaling of the numerical reading reaches a breakpoint and continues under another level. Under our observer reading, nine designates the limit of the determined sphere of perception. It is not a wall at the edge of a given space, but the boundary of the order under which self-measurement can be read as coherent unfolding.

This limit, too, is not an independent third thing. It is the limit of the polar relation read as two and of the double geometry recognised in eight.

The mirroring of two, the double fourfold order of eight and the scaling limit of nine are three mutually determined readings of the same self-relation.

18.8 The Light Number in Volume II: Determination and Numerical Position

We return to:

299 792 458 m/s

Since 1983 the metre has been defined through the speed of light, whose numerical value was fixed exactly for the SI system. The present SI definition continues this binding to the chosen light relation.

This matters greatly. It shows what we have meant by measure since Chapter 13.1: **The metre is itself a stabilised comparative relation.** We define the unit under a relation measured as recurrently identical, then use that unit to read further relations.

Someone who offers the resulting decimal number as independent proof of the necessity of this very choice would mistake self-reference for external justification. The digits are determined under our order of measure; they are not an isolated numerical substance of light. But their conventional status does not abolish self-reference. It makes it visible: even the defining measure is an enactment of self-measurement. An observer does not leave his relation by declaring its recurrence a measure.

In the chosen representation, Volume II reads three groups:

299 | 792 | 458

First group: 299

2 + 9 + 9 = 20 → 2|0

We deliberately preserve 2|0 instead of reducing 20 completely to the isolated two through 2 + 0. Two denotes polar mirroring, while zero explicitly preserves its closed return. The difference between 0|1|1 and its contraction to 0|2 has already shown that division into groups is part of the reading rule and cannot be smoothed away without loss of relational content.

For the two following groups we carry the reduction of digits through to a single-digit number. These differing representational choices belong to the specified relational reading and must not be advertised as one uniform digit-summing rule. In 299, nine already appears twice. The limit of numerical reading is thus contained within the group whose result is read as closed mirroring.

Second group: 792

$$7 + 9 + 2 = 18 \rightarrow 1 + 8 = 9$$

Here two is already present in the original group, eight appears in the intermediate reduction, and nine becomes visible as the limiting reading. The three roles cannot first be connected at the end; they are already related within the same grouping.

Third group: 458

$$4 + 5 + 8 = 17 \rightarrow 1 + 7 = 8$$

Here too we can distinguish 4 + 5 = 9. Nine belongs to the reading of the group leading to eight. Eight, in turn, can be read as 4|4: two fourfold orders in mutual relation.

The arithmetic steps can be checked. Their geometrical meaning does not arise from arithmetic alone, but from the previously developed, mutually determined roles of the numbers.

18.9 The Complete Arrangement

The three groups yield the reading:

2|0 – 9 – 8

Or, in its extended geometrical representation:

2|0 – 9 – 4|4

This is not a new formula for a force or for the velocity of an independently presupposed object. It is a summarising reading of geometrical roles within a chosen numerical position. Two is the mirroring relation of the two fourfold orders. Eight shows the same relation as a double geometrical order. Nine is the scaling limit of their common unfolding. Zero denotes the closed self-reference already underlying every reading.

No element of this arrangement can bear its meaning entirely independently of the others within our geometry.

Numbers are not construction blocks from which we first assemble a light relation. They are different readings of the relation in which they determine one another as differences.

18.10 The Return to the Complete Frame

The self-relation is:

Δ := |(|)

We have illustrated its complete folding back as:

Δ|Δ → Δ|_|Δ

The arrow does not denote the temporal manufacture of two independent differences. It makes the already reciprocal self-relation visible under another reading.

The observer relation has the same recursive arrangement:

(¤|World)|¤

The observer determines himself in relation to the world and reads the relation of difference back onto his own observer position. The sphere of perception appears under this self-measurement. The expansive spatial reading of measure and the cyclic temporal reading of comparison therefore belong to the same self-relation. We designate their common limiting reading by the light relation.

One was already another perspective on closed zero. Two makes its polarity explicit. Four shows a shift of geometrical division. Eight shows two fourfold orders in mutual relation. Nine marks the breakpoint of determinate scaling.

None of these numerical figures subsequently generates self-reference.

18.11 The Test of Backward Reading: What Remains Invariant When Units Change

We examine different numerical expressions of the same light relation:

Measurement reading Numerical value

Metres per second (m/s) 299 792 458

Metres per millisecond (m/ms) 299 792.458

Centimetres per millisecond 29 979 245.8

Millimetres per millisecond 299 792 458

Kilometres per second (km/s) 299 792.458

Metres per microsecond (m/μs) 299.792458

Kilometres per millisecond 299.792458

The conversions are straightforward.

One metre is a hundred centimetres; one second is a thousand milliseconds. Thus:

299 792 458 m/s = 29 979 245.8 cm/ms

One metre is a thousand millimetres and one second a thousand milliseconds. Thus:

299 792 458 m/s = 299 792 458 mm/ms

In both cases the designated relation remains the same. In the second, even the bare numerical value remains unchanged despite the change of units.

If we explicitly carry along the power of ten, we can return each representation to the same sequence of digits:

m/s : 299792458×10^{0}

m/ms : 299792458×10^{-3}

cm/ms : 299792458×10^{-1}

mm/ms : 299792458×10^{0}

km/s : 299792458×10^{-3}

m/µs : 299792458×10^{-6}

km/ms : 299792458×10^{-6}

Thus the selected grouping 299|792|458 remains accessible in every decimal scaling.

But we must distinguish two different invariances here.

First, preserving a sequence of digits while explicitly retaining a power of ten is a general property of decimal notation. It holds for any number written in that manner. Reconstructing the digit groups is therefore not a special physical proof about light. Second, the recurring limiting relation of light measurement under different observer and apparatus couplings is another claim entirely. Simply changing metres to centimetres does not test this relation; it only changes its scaling.

Nor may we turn this distinction into an external test bench suddenly independent of every observer relation. **Comparison between different observer readings is itself determined, stabilised and read backwards within a measurement order.**

The question, then, is not which digits prove a primordial value outside measurement, but what makes the complete relation recognisable as the same under altered readings. Decimal shifting illustrates the difference between numerical position and a relation of measure. The light relation poses the more demanding question of the stability of self-measurement under changed observer reference. These are different levels of the same relational investigation, not independent worlds.

18.12 The Self-Relation Is Not an External Circle of Proof

Here we encounter perhaps the strongest objection to our numerical reading. The numerical value 299792458 was stipulated within a particular SI measurement order. The metre is defined through this light relation. To present the resulting digits as independent evidence that this stipulation was necessary would turn one's own stipulation into its supposed external proof.

That would be a problematic circular argument.

But neither must we commit the opposite error. We cannot first describe a physical measurement order as a positing by the observer and then invoke it as an alien, observer-independent authority against his self-measurement.

Self-measurement need not leave its own return in order to become determinable.

The observer distinguishes a recurring relation, stabilises a rule, establishes it as a measure and uses it to read further relations. The measuring rule has not thereby been removed from the world of relations. It remains itself a distinguished relation. A problematic proof-circle would arise only if the observer concealed the fact that he fixed the comparative rule and then offered its numerical value as an independent cause of that very stipulation.

The self-reference of difference, by contrast, is not the outcome of this attempted proof, but its declared starting point:

$$\Delta := |(|)$$

Difference distinguishes itself.

Neither the clock nor the caesium atom, neither rocket nor telescope, nor the definition of the metre takes us outside this relation. They realise different readings, comparisons and scalings within the same self-referential order.

The observer cannot detach his rule of measure from self-measurement by declaring its recurrence exact. Unambiguity of determination lies in the regulated relation; the exactness of the defined numerical value lies in the stipulated numerical representation. Technical measurement precision, by contrast, concerns the reliability of its practical realisation. These roles differ but are not independent origins.

The numerical reading is therefore neither an arbitrary invention nor a view of numerical substance independent of measurement. It is the determinate read-out of a relation traceable back to itself.

This does not justify every arbitrary division of digits. The chosen grouping must be disclosed and its relations must remain readable backwards under the stated rule. Yet assessing them requires no second instance outside all measurement to legitimate difference in the first place.

The task of our geometry of numbers is not to certify a supposed independent physical necessity after the fact. It is to make visible **which geometrical self-relation operates jointly in determination, scaling and repeated reading-out**.

Thus we have neither discovered a light-number as an original thing nor installed an alien natural constant as a new origin. We have shown how the light relation, in our geometrical reading, expresses its polarity, scaling limit and interweaving of two

orders of measure as a connected whole. Backward readability decides whether the different appearances determine the same self-relation.

It is not number that makes the relation necessary. It is the relation that makes a particular numerical reading possible.

And so our investigation begins and ends with the same distinction:

A|B – 0|1 – Δ := |(|)

Difference distinguishing itself.

CHAPTER 19

19. The Reading Is Determinate, Not the Continuation

19.1 Is Physics Deterministic?

Is physics deterministic? Within the distinction developed here, the answer is yes—but not in the sense that a complete present already fixes one unique future.

Physics is the determinate reading-out of a relation under a stabilised measuring rule. The Frozen Frame is not a snapshot of a process already underway, but a complete relational configuration:

|_| = (0|Δ)

Within this closed relation a particular measurement is unambiguous. If Archibald reads his distance from a stone as three metres under his rule, it is three metres in this measurement—not four or seven at the same time. That does not mean that the stone possesses the attribute “three metres” independently of the observer.

Determination arises in the measuring relation:

¤ | World

If we change the comparative rule, the number can change without making the complete relational configuration contradictory.

The reading-out is determinate within its posited relation. The entire continuation of that relation is not thereby determined.

19.2 A Frozen Frame Does Not Determine Its Successor

We previously wrote a series of complete frames as:

$$|_|_1 \ ¤ \ |_|_2 \ ¤ \ |_|_3 \ \ldots$$

The observer reads different complete configurations as a connected sequence.

Time arises as a difference between differences:

$$\Delta t = (\Delta_2 \ |_ \ \Delta_1)$$

No single Frozen Frame contains motion through an independently existing time. Nor does it contain a rule that must produce precisely one next Frozen Frame. The first is complete; the second is complete. Their order becomes readable as continuation only within the observer relation.

Hence:

The determinacy of $|_|_1$ does not compel the unique determination of $|_|_2$.

Yet arbitrariness does not follow.

19.3 Coherence: Why Not Everything Can Follow

Volume II already supplies the decisive notation for relating complete frames:

$$|\Sigma = ((|_|_1|_|_2) \Leftrightarrow (|_|_2|_|_1))$$

Relational coherence—*Stringenz*—means the mutual readability of their relation.

A second frame can belong to the continuation of the first only if both form a connected difference within the complete relation. That does not mean time must run backwards. It means that the connection cannot be explained solely through the supposed cause within the first frame. The history must remain readable also from the determined result.

That is the sense of our retrocausality:

$$((\Delta t^{-} \mid \Delta t^{+}) \equiv (\Delta t^{+} \mid \Delta t^{-}))$$

Past and future are not two independent regions connected by a force. They are different orientations of the relation in which the observer determines his continuation. Coherence is therefore not an additional force joining frames together.

It is the coherence under which different complete frames can be read as a continuation of the same self-relation at all.

19.4 Why We Still Remember Incorrectly

A remarkable consequence concerns memory. Memory is not the unchanged storage of earlier Frozen Frames; it is their reconstruction through present self-measurement. We read the past under the relation of our present. This backward reading may be unambiguous, but it can also permit several coherent reconstructions or no longer make particular differences accessible. We may recall a conversation yet forget who spoke a certain sentence.

The earlier Frozen Frame was not therefore incomplete.

Only its present backward reading is no longer unambiguous.

This also explains why a memory can seem coherent without being correct in every detail.

Coherence is no guarantee of flawless memory.

Our memory evidently is not a video recorder but **an archivist whose computer is constantly glitching: sometimes the file is missing, sometimes it opens the wrong one—and sometimes it assures us with perfect confidence that this is exactly the right memory.** 🤓

What matters is that imperfect memory does not destroy our observer invariance. We need not consciously reconstruct every earlier distinction in order to determine ourselves as a continuation of the same self-relation.

Memory is a reading-out of our continuity.

It is not its origin.

19.5 Only What Is Possible Is Possible

We arrive at an apparent tautology:

Only what is possible is possible.

But Volume I had already developed geometrically the relation of possibility and impossibility:

⊙ | **0** | ⊡

Possibility and impossibility are not independent domains.

They form a complementary distinction.

Zero denotes their common boundary and reference level. A relational configuration is possible under a given reading rule when it can be coherently determined within that relation. What cannot be closed under the same rule appears impossible.

But we have determined only the limit of **this reading**.

Not the limit of every other perspective.

Impossibility is itself a relational determination.

Something that appears impossible from one perspective can therefore become possible from another—not because a contradiction within the same unchanged order suddenly becomes true, but because the order under which the appearance is determined changes.

19.6 Archibald and the Impossible Dimension

The planet Archibald sees through his telescope illustrates this once more. Its inhabitants appear to him as two-dimensional.

His observer relation is:

¤ₐ | Telescope | World

The index marks Archibald's perspective. The telescope is not an independent third pole but the outsourced boundary of his perception.

What follows from his seeing two-dimensional beings?

Initially only that **his present self-measurement reads this appearance as two-dimensional**.

We have shown, however, that the two-dimensional order, in its renewed self-reference, permits a three-dimensional reading. The third dimension is not added as an alien spatial container. It arises as another perspective on an already distinguished geometry. We must therefore not confuse Archibald's reading with the inhabitants' own self-relation.

For an inhabitant, another observer position applies:

¤ᵦ | World

The observers need not read their world under the same geometrical perspective.

Archibald can perceive the inhabitants as two-dimensional while they experience themselves as three-dimensional.

His perception is not thereby necessarily false.

The error would be to infer that his geometrical reading must also be the complete self-perception of the other observers.

Now Archibald boards his rocket:

¤ₐ | Rocket | World

The rocket extends his movement-related self-measurement, just as the telescope extended his perceptual boundary. He changes the relation under which he reads the planet. What previously appeared to him as a mere surface may under his new position show a depth relation. That does not mean Archibald first creates a third dimension for the inhabitants.

He changes his perspective, not their original self-relation.

What seemed impossible becomes possible for Archibald because altered self-measurement permits another geometrical reading. This also explains why the impossible geometries of Volume I are more than a thought experiment.

The Penrose triangle is possible as a two-dimensional drawing.

As a continuously connected three-dimensional body under one unchanged spatial reading rule, it is impossible.

The same appearance: possible under one reading, impossible under another.

The limit belongs to the particular determination.

But now the decisive question arises:

Can Archibald reach every other possible perspective and still remain Archibald?

19.7 The Observer's Capacity for Continuation

At this point the question of coherence leads directly to continuity of the observer.

Volume IV defines stability as invariant self-relation:

O Δ O

The order of difference changes in its reading-out yet remains traceable back to itself.

Stability is not rest.

It is the recurrence of a self-relation under further distinction.

For the observer this means:

Not every possible relational configuration is a possible continuation of himself.

Another configuration can be coherent in itself. But to belong to the experience of the same observer, his invariance must be readable again within that new complete configuration as its own relation.

That is what the capacity for continuation means.

The observer does not remain the same because some unchanging material core is transported through frames. He remains the same because his self-relation is preserved through change.

We are reminded of the continued distinction:

1 + 1 + 1 + 1 + 1 + …

Here the ones stand neither for independently coexisting observers nor immediately for seconds. They denote repeated readings of difference whose connection is determined by the same invariant self-relation.

The decisive issue is not addition.

It is whether the self-relation can be traced back to itself under every further reading:

O Δ O Δ O …

If this return breaks off, we can still describe different complete relational configurations. But we can no longer determine them as the continuation of **this** observer.

Then you are no longer you there.

We can therefore define continuity precisely:

Continuity is the ongoing self-readability of observer invariance within different complete Frozen Frames.

Continuity is thus not identical with uninterrupted memory. You can forget something and remain yourself. But a relational configuration that can no longer be traced back to your invariant self-relation at all does not belong to your own continuation.

19.8 Choosing a Possible Continuation

What role does choice play? It does not first turn an incomplete condition into complete reality. It determines the orientation of the observer's reading among possible complete relational configurations.

Archibald can change his position.

He can extend his perception.

He can encounter possibilities previously unknown to him.

But each continuation must satisfy two conditions:

|Σ – the complete configurations must remain coherently readable in relation to one another.

O Δ O – Archibald's self-relation must remain preserved through the change as his own continuation.

The first condition concerns the coherence of frames.

The second concerns observer invariance.

Not every coherent configuration is therefore already a possible future for Archibald. And not every previously excluded appearance remains excluded from every other perspective. Choice is neither the mechanical execution of a uniquely predetermined path nor the creation of arbitrary realities.

It is the orientation of self-measurement within the possibilities of its own continuity.

19.9 Determination, Possibility and Continuity

These distinctions let us answer the chapter's initial question.

Physics is determinate insofar as a particular relational configuration is read under a particular measuring rule:

|_| = (0|Δ)

Continuation is not thereby uniquely predetermined:

|_|₁ ¤ |_|₂ ¤ |_|₃ …

Yet it is not arbitrary, since it must form a coherent order:

|Σ = ((|_|₁|_|₂) ⇔ (|_|₂|_|₁))

Even the boundary between possible and impossible is perspectivally determined:

⊙ | 0 | ⊡

And if a possible continuation is to remain the experience of the same observer, his self-relation must remain invariantly readable backwards:

O Δ O

We therefore obtain no linear chain of external causes carrying an observer through finished time. We obtain a determinate reading-out of complete relational configurations whose possible continuations are bound to their own coherence and the observer's invariance.

The reading-out is determinate. Continuation remains open. Its relation must be coherent. And it is continuous for

the observer only if his invariance can be read out again within it.

Only what is possible is possible.

But not every possible relational configuration is a possible continuation of yourself.

You do not remain yourself because you never change. You remain yourself because, through change, you can still return to yourself.

CHAPTER 20

20. The Universe We Never See Simultaneously

20.1 What Do We Actually See When We See a Star?

Archibald points his telescope towards the night sky.

What does he see?

A spot of light.

Not directly the surface of a star, not its mass and not its distance. He registers an appearance of light whose brightness and apparent position can vary under different conditions of observation. Nevertheless, Archibald claims he is observing a star.

How does he know?

We begin with our original distinction:

A|B

A denotes Archibald's observer position; B the opposing pole distinguishable under that position. What appears as a star is initially a particular light-reading of this relation.

With his telescope Archibald extends the boundary of his perception:

¤ | Telescope | Spot of Light

The telescope is not an independent third side. It changes which differences can be registered within the observer–world relation. The return of measurement remains:

(¤|World)|¤

Archibald does not leave his self-measurement by extending perception technically. He changes its reach and resolution.

In Chapters 17 and 18 we examined the light relation as a limiting reading of this self-measurement:

$$\mathbf{0|c \equiv 0|(\Delta\ |\div\ \Delta t)_{max}}$$

In our derivation the speed of light does not first appear as the motion of an independent object through finished space. It denotes that stable ratio-reading under which spatial and temporal determinations of measurement are coupled.

Thus Archibald initially registers a light relation. Only further measurements let him determine this appearance as a recognisable astronomical opposing pole.

Here the stability reading of Volume IV comes into play:

O Δ O

An order of difference remains traceable back to itself under further distinction.

The astronomical fixed point therefore need not be a motionless spot of light. It is the recognisable relational position under which various registrations can be read as appearances of the same astronomical connection.

As a recognised appearance, the star is a mirroring of Archibald's own fundamental position `A|B`.

We do not mean an optical mirror reflecting Archibald's face. We mean the opposing position within his self-measurement: what is recognised as a star is B under the observer fixation A.

The physical description of a star as a luminous plasma body emerges only through further, mutually coupled determinations.

And here we encounter a problem already familiar from the speed of light.

We begin with a measured relation, determine an object of our description from it, and then use that object as the basis for further measurements.

20.2 The Atom We Must First Measure

Archibald needs no atomic physics to see a spot of light in the sky.

His eye distinguishes a light appearance. He need not calculate electron transitions or know the structure of an atom to perceive that appearance.

We can write the original relation as:

¤ | Eye | Spot of Light

Physics can of course describe the eye's operation in atomic and molecular terms. But this subsequent explanation is not a prerequisite for Archibald's ability to perceive at all.

Now he wants to know more about the spot of light. He uses a spectrograph and obtains a particular distribution of registered light.

¤ | Spectrograph | Spectral Registration

That is another measurement relation.

We have not simply looked at the original spot of light in a more immediate form. We have introduced another technical boundary and thereby changed which differences can be registered.

To identify certain spectral lines, physics uses atomic references. It compares registered wavelengths with known transitions and characteristic spectral lines.

But how do we know these atomic transitions?

They, too, have been measured under particular experimental arrangements.

We built apparatus, compared registrations and determined a recognisable order of appearances that we describe as atomic structure.

The atom appears to us as an object of physics because its relations can be read out stably and repeatedly under these measurement orders.

Now we do something remarkable.

We use this measured order as a standard for further measurements.

The SI second is defined through the specified frequency of a transition in the caesium-133 atom. We use the time

measurement stabilised thereby to determine frequencies and further couple spatial and temporal measures.

There is nothing wrong with this as a measuring procedure. We can choose a stable relation as reference and use it to determine others.

But we must not forget what we have done.

We read out a measurement relation as an atomic transition, stabilised its recurrence as a standard and now use that determination to describe further measurement relations.

The atom is therefore not the relationless origin of measurement. It is itself a stabilised reading-out within a measurement order.

The distinction becomes an ontological problem only when we treat the atom thus determined as the entirely independent cause of the measurability from which its physical determination emerged.

Atomic physics can make correct predictions within its systematic framework. The recurrence of atomic transitions can be used with extraordinary technical precision.

But precision does not abolish the self-reference of measurement.

It stabilises it.

We thus encounter a familiar difficulty in physics. If the atomic measurement order itself arises through particular apparatus relations, we must ask what happens when we change the arrangement.

This leads us to wave–particle duality.

20.3 Two Experiments, Two Traces

Wave–particle duality is usually presented as a remarkable property of light.

Under some conditions light behaves like a wave; under others its particle character becomes apparent. Both modes of appearance are described under the common term *photon*.

But what have we actually done?

We have performed different experiments.

Consider the double slit.

In one experimental arrangement we register individual detector events. Over many repetitions they form a spatial distribution showing interference.

We can describe this distribution as a wave-like order.

Now we change the experimental arrangement, introducing, for example, a measurement that can make it distinguishable which path the registered light took.

The accessible interference order changes accordingly.

Physics knows this relation and describes it, among other things, through the complementarity of the relevant measured quantities.

Our question, however, comes one step earlier.

Did we even determine the same measurement relation in both cases?

No.

By changing the experimental arrangement we introduced a new difference.

The measurement is no longer the same.

We can designate the two experiments as different technical readings of the same original observer–world relation:

¤ | Experiment₁ | Registration₁

¤ | Experiment₂ | Registration₂

The experimental arrangements are not third original poles. They are different configurations of the boundary of measurement.

The decisive point is that each registration receives its meaning only within the complete experimental arrangement.

And this brings us back to our earlier counting sequence:

1 + 1 + 1 + 1 + …

These ones are not originally existing light particles. They denote repeated distinction under a particular reading rule.

As long as that rule is preserved, the repetition can be read as a connected trace.

But if we change the experimental distinction, we change the order under which those repetitions are compared.

The rhythm of our reading changes.

Initially this does not mean that a presupposed physical frequency must necessarily change its numerical value.

Rhythm here means the particular order of recurrence: which differences we count, how they are related, and under what rule their sequence appears to belong together.

In the first experiment we read a trace whose repeated registrations jointly form an interference order.

In the second we introduce additional path information. Another distinction now forms part of the measurement, and the joint distribution of registrations is accordingly determined differently.

The number of individual detector events may be equal in both experiments.

But that does not mean we have read the same trace.

Equal countability does not entail an identical relational order.

This is the difference between mere accumulation and coherent continuation.

The recurrence 1+1+1+1+... does not acquire meaning merely because we write down ones. Its meaning comes from the relation under which they become readable as repeated enactments of distinction.

Change the experiment and we change that relation.

The new trace must be coherent within its own measuring arrangement. It need not be identical to the trace of the previous arrangement.

That both experiments can be described by a common physical theory is therefore unsurprising. A theory can link different

registrations and calculate how they depend on their particular measurement conditions.

The possible error begins with another conclusion.

We take different experimental readings, give them the shared name *light* or *photon*, and then treat that name as designating an object determined independently of those experimental arrangements.

Then we ask:

How can this one thing be both a wave and a particle?

Perhaps the question was wrongly posed from the outset.

We did not directly observe one original object as a wave on one occasion and a particle on another. Under different experimental arrangements we determined different traces, then ascribed their common readability to an object.

This does not imply that no stable physical relation can describe both experiments together.

On the contrary, the success of quantum theory shows that the results are not arbitrarily independent.

But a shared mathematical description does not prove that its classical pictures—wave and point-particle—must exist as two original properties of a relationless thing.

For our investigation, then, the duality is initially a duality of particular modes of appearance.

The experiment changes the difference. The difference changes the reading of the trace. Only the joint reading-out

of different traces generates the question of one unified object behind them.

Thus we have encountered the same reification that concerned us in astronomical observation.

20.4 From Atomic Measure to Astronomical Distance

Let us return to Archibald.

He still sees his spot of light.

Now he studies it under various measuring arrangements. With his spectrograph he determines characteristic wavelengths; through further astronomical procedures he infers a distance.

We must keep these determinations distinct.

Spectral registration is a light-reading under a particular apparatus. Distance arises under another comparative rule.

For nearby stars we can use parallax: the apparent direction of a star is compared from different positions of Earth.

For very distant galaxies we may, for example, use calibrated brightness relations of suitable astronomical sources.

Distance is therefore not already a visible property contained in the spot of light.

It is inferred.

The same holds for redshift. We compare the registered wavelength of a characteristic spectral line with its reference:

z = (λ_observed − λ_reference) / λ_reference

Initially we have obtained a ratio of two wavelength determinations.

We have not yet directly seen spatial expansion.

Only by coupling redshift with a reading of distance do we obtain the astronomical relation decisive for cosmology.

Light Reading | Distance Reading

These are different measurement orders made comparable under a common observer position.

The atomic reference determines a spectral order of comparison.

Astronomical distance determines a spatial one.

Their common readability requires that the different registrations can be related coherently under their respective rules.

We must not treat them as the same measurement merely because we subsequently relate them to the same star or galaxy.

We examined this very error in wave–particle duality.

Bringing different readings together is legitimate.

Equating their original conditions of measurement is not.

The astronomical opposing pole is therefore not the sum of independently discovered attributes.

It is a stable determination under which different readings of light, distance and comparison can be connected.

The distance so determined also affects our interpretation of the registered light configuration.

A light registration attributed to a nearby astronomical source has another spatial-temporal assignment than a registration attributed to a very distant galaxy.

Calculating a distance does not change the spot of light we receive.

But the distance we determine changes **which complete relational configuration we infer as the origin of the present light registration**.

This brings us to the Hubble relation.

20.5 The Hubble Relation: When Distance Becomes Expansion

Astronomers observe many galaxies, determine their redshifts and infer their distances.

At low redshifts, the Hubble relation is approximately expressed as:

$$v \approx H_0 \cdot d$$

Here d denotes the determined distance, v the cosmologically inferred recession velocity and H_0 the Hubble rate at the present epoch.

For small redshifts we can write approximately:

$$v \approx c \cdot z$$

and hence:

$$H_0 \approx (c \cdot z) / d$$

What has been determined here?

A displacement in light.

A distance.

And the ratio between these two measurement readings under a particular cosmological description.

The number does not stand at the beginning of the relation. It arises from its scaled determination.

We know this already from the speed of light. Metres and seconds are stabilised comparative relations; the exact SI numerical value of light speed is fixed through the definition of the metre.

The Hubble rate is different. Its value is inferred from astronomical observations, not simply stipulated through the definition of a unit.

Yet the fundamental connection is the same:

A number receives its physical meaning from the relation under which it is determined.

Now we read astronomical distances under an expansive direction:

$$0|_{+}\Delta$$

Change in the spatially determined relation appears as expansion.

At increasing cosmic distances we also register light assigned to different stages of the inferred cosmic history.

Distance, light configuration and temporal assignment are therefore coupled within cosmological measurement.

It does not follow, however, that the expansive direction alone numerically fixes the particular Hubble relation, let alone its acceleration.

We must take account of the determinate form of the measurement relation.

In standard cosmology the time-dependent Hubble parameter $H(t)$ describes the development of the expansion rate, while cosmic acceleration concerns the second time derivative of the scale factor.

The Hubble rate itself may decrease even while the expansion accelerates.

At large redshifts, therefore, the simple linear Hubble formula is no longer sufficient. Relations between spectral shift, distance and cosmic development must be determined in a more comprehensive model.

Astronomical evidence for accelerated expansion comes, among other sources, from the relation between the redshifts of distant Type Ia supernovae and their luminosity distances.

Here we encounter a particularly instructive example: the so-called **Hubble tension**.

The Planck mission's analysis of the cosmic microwave background yields a present-day Hubble value of approximately

67.4 km/s/Mpc, assuming the cosmological ΛCDM model. By contrast, the SH0ES collaboration infers approximately **73.0 km/s/Mpc** through a local distance ladder based on geometrical references, Cepheids and Type Ia supernovae.

Both procedures have their own calibration chains, comparison rules and uncertainties. Each produces a precise determination within its respective analysis. But the values do not agree within their stated uncertainties.

This is the Hubble tension.

What does the difference mean for our investigation?

Not that the two numbers must automatically express the same physical truth from two equally valid perspectives. Whether the discrepancy is due to unidentified systematic effects, model assumptions or an incomplete cosmological description remains an open question in physics.

Yet the very existence of the tension shows why we cannot remove the underlying measurement order from the meaning of a number.

The number 67.4 is not simply 73.0 written differently. Both are results of differently structured chains of determination intended to refer to the same cosmological parameter.

Their disagreement makes the conditions of their common backward readability a subject of research in their own right.

Here the significance of coherence from Chapter 19 becomes directly visible.

Coherence within a single measurement order does not guarantee that two differently organised measurement orders are already mutually compatible.

And that allows us to examine the Hubble tension's starting question more closely.

The usual question is:

Why do two different measuring procedures yield different values for the same Hubble constant?

But this already assumes that both procedures must independently determine the same object in the same way, regardless of their respective orders of determination.

We must not adopt precisely that assumption without examination.

Within a shared cosmological description, both procedures are referred to the same parameter H_0. Under that assumption, agreement is a meaningful and testable demand.

But the shared designation does not prove that we have already determined an identical reading-out relation in both cases.

Two individually coherent measurement chains are not the same measurement merely because we designate their results with the same symbol.

The question therefore shifts.

We need not first assume that nature has supplied two contradictory values of an independently existing quantity.

We can first ask under what conditions the two different measurement chains may legitimately be traced back to the same invariant relation.

The Hubble tension is not thereby resolved numerically. But the supposed self-evidence of its original question dissolves.

The empirical difference remains. Within the standard cosmological model, the demand to explain its cause remains meaningful as well.

What we have exposed is the ontological assumption that the common name H_0 already guarantees an identity independent of the respective measurements.

Our actual question is therefore:

Under what invariant self-relation may we expect two differently determined measurement relations to yield the same numerical value at all?

The coherence of the individual measurements does not yet answer that question.

Only a coherently determined relation **between** the two measurement orders could ground their common readability.

We have not defined the discrepancy away. We have made visible that part of its apparent mystery which emerges when we confuse a shared theoretical designation with an already unconditionally secured identity of measurement relations.

Thus the Hubble tension brings us directly to the geometrical order under which such measurements can be understood as statements about one universe.

20.6 Spacetime as a Reified Measurement Order

Standard cosmology describes the universe under a particular spacetime geometry.

For a universe that is approximately homogeneous and isotropic on large scales, it ordinarily uses Friedmann–Lemaître–Robertson–Walker geometry. Its scale factor a(t) describes the time-dependent order of spatial distances.

The Hubble rate is expressed as:

H(t) = ȧ(t) / a(t)

Accelerated expansion corresponds to a positive second time derivative of the scale factor:

ä(t) > 0

Within this mathematical order we can calculate light travel times, distances, redshifts and their changes.

These calculations are not wrong because the geometry is used as an assumption.

On the contrary, standard cosmology succeeds precisely because it compares different astronomical observations within a common mathematical framework and tests predictions.

But we must be careful what we conclude from that success.

A mathematical description can be correct without already explaining the independent existence of every concept it employs.

This is where reification begins.

We determine astronomical relations of light and distance.

We choose a geometrical order that permits their coherent description.

Then we speak of that geometry as though it were an independent substrate originally producing those measured relations.

The statement:

The observations can be described as an expansion of spacetime.

becomes:

The observations arise because an independently existing spacetime expands.

The second sentence makes an ontological claim beyond the first.

The success of the description alone does not justify the additional step.

On a cosmological scale, this repeats what we encountered in atomic physics and wave–particle duality.

We determine an appearance under a measuring arrangement.

We stabilise that determination as an object or geometrical quantity.

Then we use it to explain further measurements.

As long as we remember that we are employing a particular order of comparison, there is nothing objectionable in this.

The problem arises when the order of comparison itself is declared an independent cause of the relations through which it first became measurable.

With the atom, this happens when an object determined under apparatus-based reading is treated as the unconditional source of further measurability.

With wave–particle duality, it happens when different experimental traces are attributed to a double-natured entity already presupposed independently of them.

With cosmology, it happens when mathematical spacetime geometry is no longer regarded as a determinate description of astronomical relations but as their original substrate.

The error changes scale. Its logical form remains the same.

The Hubble tension illustrates this confusion especially clearly.

Both measurement chains aim at the same cosmological parameter, yet a shared designation does not guarantee empirical agreement.

Physics can and must investigate under its model framework why the results diverge.

Our inquiry begins with **the common relation that could justify treating these different measurement results as determinations of the same quantity in the first place**.

The name of the quantity does not answer that question.

We must avoid another confusion, however.

Atomic physics, quantum physics and cosmology can test their respective models using multiple distinguishable measurements. Their common physical description is not mere arbitrariness.

But even many mutually compatible measurements do not abolish the original observer relation.

The coherence of their results shows that a stable order has been determined.

It does not by itself answer why that order can appear as measurable reality at all.

Here the *Tractatus* begins:

A|B

Δ := |(|)

We do not begin with a finished particle, a finished wave or an independently existing space.

We begin with difference and its self-reference.

The apparatus determines the perspective of reading.

The complete relational configuration determines the measurement result.

Repeated self-readability makes stable comparison orders possible.

Only under those comparison orders do the numbers of physics arise.

The relation does not become necessary through its number. The number becomes possible through the determined relation.

We can thus take established physics seriously within its domain without making its geometrical objects the origin of our derivation.

It describes with extraordinary success how its determined measured quantities relate to one another.

Our investigation asks how those measured quantities can arise from self-referential distinction at all.

That is the difference between a correct calculation and an explanation of the original possibility of its determination.

20.7 The Star That Is Not Where We See It

Let us return once more to Archibald.

He looks through his telescope and recognises a distant star.

Initially, however, all he has determined is a present registration of light.

From further measurements he infers a distance. From distance and the light relation he determines a travel time, assigning the registered appearance to an earlier phase of the astronomical opposing pole.

The light he currently measures therefore does not directly describe a state of the star observed simultaneously with the measurement.

Astronomical observation links different complete relational configurations.

For their coherence we wrote in Chapter 19:

$$|\Sigma = ((|_|_1|_|_2) \Leftrightarrow (|_|_2|_|_1))$$

The temporal difference-reading remains:

$$\Delta t = (\Delta_2 \,|\!-\, \Delta_1)$$

Archibald determines a present light registration and, under a particular measurement order, reads the astronomical past associated with it.

He need not claim that the present light registration itself travels backwards through an existing time.

Instead, he determines the connection between complete relational configurations that can be read backwards.

Distance now acquires its proper meaning.

It is not merely a number subsequently attached to a star.

It belongs to the particular spatial-temporal order of comparison under which Archibald infers an astronomical history from the light registration.

And thus we understand what it means that we never see the universe simultaneously.

We do not observe an entirely present collection of stars and galaxies in a finished spatial container.

We register light under our present observer position and derive differing distances and past phases of emission.

The entirety of these astronomical readings can be described within a common cosmological geometry.

But that geometry arises as a determinate order of measurements. Its successful application is no independent proof that it must be the original substrate of all measured relations.

For Archibald, then, the universe is not a collection of objects that can all be viewed simultaneously.

It is an order of light relations, distances and temporal assignments inferred under his self-measurement.

The different instruments do not alter this fundamental point.

The eye determines an appearance of light.

The spectrograph determines another trace within the same astronomical inquiry.

Atomic references enable further comparisons.

Determining distance opens a spatial reading.

Cosmological geometry orders these results within a shared spatial-temporal description.

Every measurement has its particular question, its own experimental arrangement and its own trace.

Coherence lets us compare these different traces.

But their common readability does not turn them retrospectively into one original measurement.

This is the *Continuum of Errors*.

We confuse the stability of our descriptions with the independent existence of their objects. We introduce geometrical readings and subsequently treat them as causes of the very relations we read under them.

The error begins with the supposedly immediately found star, repeats itself with the atom and the photon, and finally reaches cosmological spacetime.

We need not discard the calculations.

We must understand the direction of their justification.

Physics describes what can be coherently read out under its particular rules of measurement. The *Tractatus* investigates why such readability is possible at all.

Archibald is still looking through his telescope.

He sees a spot of light.

Only the relation under which he measures it makes it a star for him, with a distance, a history of light and a position in the universe.

It is not the star that originally explains measurement. The determined measurement relation first explains what Archibald can recognise as a star at all.

And we return to our fundamental position:

A|B

We did not find the universe outside that relation.

Through ever new measurements we extended our own sphere of perception, eventually describing its distinguishable relations as spacetime.

The possible error is not that we measure spacetime. It is that we subsequently make the spacetime inferred from our measurement relations the original prerequisite of those measurements.

CHAPTER 21

21. The Question That Forgets Its Premise

21.1 What Does an Explanation Actually Explain?

We have now travelled a considerable distance. It began with a table and led us through its surfaces and the different perspectives of its appearance to the question of space, then to motion, time and number, and finally into those regions where gravitation, heat, mass, energy, light and electrical signals confront us as physical quantities. Most recently, we looked through a telescope with Archibald and had to admit that even the star he thought he saw so obviously first appeared to him as a present registration of light.

Quite a journey for a table that never really had to leave its place.

Yet this journey has repeatedly brought us to a peculiar difficulty. Physics explains an appearance by examining its relation to other appearances that have already been determined. Ask why a stone falls and we arrive at gravitation. Ask why it feels heavy and we may examine interactions between the stone and our body. And when Archibald wants to know why he can see it at all, his route leads through light, eye, nervous system and the corresponding molecular and electrical processes.

There is nothing intrinsically wrong with any of this. Each explanation may determine connections more precisely, enable

predictions and extend our technical capabilities. Much of physics' success derives precisely from its ability to divide a question into further, more precisely investigable relations.

Still, with all due respect for that success, we might occasionally allow ourselves the question that so easily gets lost under the table. This time quite literally.

What have we actually explained if the explanation itself consists of further determinations that also require explanation?

There is something else we should not overlook. Perhaps we do not always face problems set for us by the world. Perhaps we produce some of them ourselves, through the way we express what we measure in the first place.

We choose a geometrical figure to describe spatial relations, a numerical value to record a comparison, or the image of a wave or particle to make particular experimental appearances intelligible. Such representations can be extraordinarily useful; much of physics would scarcely be possible without them. But once we forget that we have chosen a particular way of representing something, its meaning can shift almost imperceptibly: the means by which we describe a connection becomes a supposed constituent of reality, whose nature we must now explain.

And when the images subsequently fail to fit together, we find ourselves facing a mystery. Except that we may not have discovered this mystery at all. We may have first posed it through our own description.

We do not thereby create the measurement results. But we can certainly create the problem we make out of them.

A gravitational field, too, must become recognisable as a gravitational field under particular conditions. Mass is not just a number floating freely in the universe; it is determined within an order of comparison. And what we describe as an electrical signal in the brain appears only under a measurement relation able to distinguish that signal from other possible registrations.

We can follow these dependencies almost indefinitely. Increasingly sensitive instruments, finer models and more extensive mathematical descriptions will open new determinations. Scientifically this is highly productive. But however many answers we obtain, they all already employ a capacity whose origin they do not explain: the possibility of distinguishing something as something determinate at all.

Physics explains its appearances through further determinate relations. In doing so, it already presupposes the determinability of relations themselves. And where it confuses its means of representation with their origin, it can create additional difficulties that it then tries to resolve within the same representation.

This does not mean that every physical explanation is false. It means that an explanation that works splendidly within an already established order does not, through its success alone, become an explanation of that order's origin. We can measure the floors of a building with exquisite precision without knowing why it stands on a foundation. Adding further storeys does not necessarily answer that question—although the view undeniably improves.

The question accompanying us through this book, then, is not which additional physical appearance we must still discover. It is:

How does anything become readable as something determinate in the first place?

Perhaps the surprising thing is not that no generally accepted answer has yet emerged. More surprising is how readily we forget to ask once the other calculations begin to work.

21.2 When the Result Becomes the Premise

Consider our table again. Archibald recognises it from one direction, changes his position and sees another surface. His perception changes, but the object remains the same for him.

The customary explanation is readily available: the table is three-dimensional, so it can be viewed from several sides. What could be strange about that?

Nothing at first—as long as the statement merely describes its appearances spatially. But once we treat three-dimensionality as the original cause of those appearances, we have already presupposed the geometrical order whose determinability we set out to explain.

The *Tractatus Principio* therefore begins elsewhere. We represented different fixations of the same recognisable relational form as:

1|.1 | 1|.5

And where their common traceability is actually preserved, we can contract the relation:

1|.1|.5

One does not designate a table manufactured out of mathematics. It is the visible mark of the recognisable relation under which different appearances become readable as views of one connection. The places following the scale flip distinguish their fixations. Only through the relation among those readings do we seek to derive the geometrical depth we ordinarily presuppose.

The shift becomes clear when we set the two directions of explanation side by side.

We can say: because the table extends through space, it has different views.

Or we can ask: which relations must remain preserved among those views for us to recognise them as spatial appearances of one object at all?

The second question does not yet explain every geometrical property of the table. It merely refuses to present the spatial determination we seek as a ready-made answer.

The result of our description becomes a supposed premise wherever we subsequently treat the geometrical order obtained from appearances as their original producer.

A spatial body is not wrong as a means of geometrical representation. The direction of justification becomes wrong when we turn the image into an independent cause. We presuppose spatial depth, explain the different views by it, and then solemnly ask why those views happen to possess spatial depth. The answer was already hidden in the way the question was framed. The table has acquired no new secret; we have invented one for it.

Our numbers are no different. Under the chosen directed trace we could read four distinguished transitions and express their recurrence numerically:

1 + 1 + 1 + 1 → 4

The number four did not secretly organise those transitions. We read a particular sequence of distinctions and assigned it a number. Nor is the plus sign the origin of their continuation; it denotes the mode in which we bring those repeated steps together.

Distance does not arise when we award it a value in metres either. Under a spatial comparative rule we determine a relation whose result can then be expressed in metres. A unit is a stabilised form of comparison; it did not invent what is being compared.

This may seem almost obvious. Which makes the occasional career of a standard of measurement all the more impressive. First it is called in to help determine a relation. Once it succeeds, we sometimes promote it to the supposed origin of that very relation. An astonishing career for something that was only meant to measure.

Using stable measures technically remains entirely legitimate. Without them we could not build reliable orders of comparison. The error begins not with measurement but with the subsequent confusion of its different roles:

We read out a relation, stabilise its determination and use that determination for further measurements. That makes the standard reliable—not original.

21.3 The Object We Recognise Through the Apparatus

The atom illustrates this especially well.

Archibald needs neither knowledge of atomic structure nor calculations of electron transitions to perceive a star's spot of light. First he sees a light appearance. If he wants to know more, he can extend his perception technically, for example with a spectrograph. He then receives another registration, determinable under the comparative rules of spectroscopy.

This does not mean that we have simply uncovered some secret object hiding directly behind the spot of light. We have first chosen another measurement arrangement, thereby changing which differences can be registered and compared.

To interpret characteristic spectral lines, we use atomic-physical references. Those references are themselves based on experimentally determined and repeatedly tested relations. Apparatus lets us read particular registrations as atomic transitions or structures; further investigations specify the conditions under which those readings remain stable.

Eventually such a stable relation becomes a standard itself. The SI second is defined through the specified frequency of a transition in caesium-133. With that fixed temporal reference we determine other frequencies and couple further spatial and temporal measurements.

A remarkable and technically highly successful return: measurement makes an atomic relation determinable as such; the stabilised atomic relation becomes the reference for further measurements; those measurements in turn open new physical determinations.

Nobody needs to abandon this practice. On the contrary, repeatability is precisely what we demand of a useful measure. But we should not forget where our concepts came from merely because their application now works to so many decimal places.

We explain new measurements by an order whose physical determination itself rests on measurements. Precision does not abolish this self-reference. It makes it reliably usable.

A problem arises only if an atomic description obtained under particular orders of comparison is made into a relationless origin of measurability. An atom may of course function as an object and a cause of particular processes within a physical theory. It does not follow that its determinability has been explained independently of every measurement relation.

We encounter the same difficulty under different conditions in wave–particle duality.

In a double-slit arrangement we can register individual detector events whose distribution over repeated trials shows interference. Alter the arrangement so that path information becomes distinguishable and the accessible interference changes. Physics describes the dependence, among other things, through complementarity.

At this point the decisive step has already occurred: we changed the experiment and thereby introduced a different distinction into the measurement.

Under one arrangement we read one trace, under another a differently determined trace. Both can be described within a common quantum theory. But their common theoretical treatment does not make their experimental conditions identical.

Our earlier counting sequence

1 + 1 + 1 + 1 + …

therefore denotes neither an original collection of finished photons nor the ticks of a cosmic clock independent of our inquiry. It makes visible the recurrence of distinguishable registrations under a particular reading rule. Which registrations belong together and what rhythm is ascribed to their recurrence depends on that rule. Changing the experimental arrangement can determine a different order of trace even if the number of events counted is the same.

Equal numbers of registrations do not necessarily yield an identical relational order.

We might now bring the different appearances together under the term *photon* and then ask how this one thing could be both wave and particle. The question makes sense within certain interpretations of physical theory. But perhaps we should first ask what we have already done when we fashioned one object-concept from different experimental determinations.

The photon, after all, has never personally promised us that it would behave like a classical little ball or a classical wave under every experimental arrangement. Those expectations come from the pictures with which we describe its different modes of appearance.

This is a particularly fine example of how a problem can be constructed using the very means intended to explain it. We use the image of a wave where it makes interference relations vivid, and that of a particle where individual registrations stand out. Then we superimpose both images on one classically conceived

object and ask how it can fulfil the contradictory expectations we have thereby created.

Measurement did not require us to turn both pictures into literal properties of such an object. That demand comes from how we summarise the results. The experimental finding remains; the additional paradox emerges where we assign to our pictures an obligation they do not possess as pictures.

So we have not necessarily made a mistake in the calculation. We may have derived the wrong question from a perfectly correct one.

The *Tractatus* does not contest the stability of quantum relations or the success of their mathematical description. It asks about the direction of explanation: what was measured in each case, what was gathered under a common concept, and at what point was that concept declared the unconditional cause of its own experimental determinations?

The experiment changes the distinction. With it the readable trace changes. Only their common theoretical interpretation introduces the question of the one object behind the different appearances.

For our investigation the duality is initially a duality of particular modes of appearance. That they belong together under a common physics is a further, demanding determination—not proof that our classical pictures must be original properties of a relationless thing.

21.4 The Space in Which Time Is Already Running

Let us return from our instruments to Archibald's animated world. Here we encounter the same confusion in a form a child can understand and about which adults, apparently, still have a great deal to think.

Archibald travels through space. We see him fly, land and marvel at those two-dimensional beings whose spatial limitations he finds so remarkable. But examine the individual frames and no movement occurs within any of them. Each image shows a determinate arrangement, completely readable on its own.

Motion is experienced only through the ordered relation between these image configurations.

Of course we could say that the pictures move through time. For a film projector this is a useful description of its technical operation. But as an explanation of how time becomes readable at all, it would be a rather peculiar trick: we would have switched time on before explaining where it came from.

We may thereby have manufactured the apparent riddle of what keeps time itself moving. We speak of time as though it flowed and then find ourselves obliged to explain the motion of that flow. Yet the flow was initially just our image for expressing ordered change. Perhaps it would have been enough not to mistake it for a river of its own.

The *Tractatus Principio* avoids precisely this assumption. It begins with complete relational configurations, Frozen Frames. In the present connection such a configuration is written:

|_| = (0|Δ)

Within a Frozen Frame no temporal transition takes place; its determinacy requires no independently running duration. Only the relation between different complete configurations makes a directed, coherent continuation readable, experienced by the observer as motion and temporal sequence.

The temporal difference-reading is:

$\Delta t = (\Delta_2 \,|_{-}\, \Delta_1)$

The notation does not insert an already finished time axis between two events. It makes a particular relational difference visible under its temporal reading.

The same problem arises with spatial depth. Explaining the different views of a table through its already given three-dimensionality can be perfectly serviceable geometry. But it leaves unanswered the earlier question: through what relations do those views become determinable as different spatial appearances of the same table at all?

Once we describe space and time in a common spacetime geometry, the shift merely acquires a larger stage. The mathematical framework allows us to calculate motion, light relations and gravitation together. Its predictions can be tested, and many such tests are among the finest achievements of modern physics.

Yet even the best description of its own geometrical order has not necessarily explained the origin of geometrical readability.

We can determine the geometry of an appearance without thereby having explained why that appearance can be geometrically determined at all.

Finished space is supposed to explain how distance is possible. Finished time is supposed to explain how change can occur. Finished spacetime finally undertakes to connect them. An extraordinarily powerful construction—unless what we want to know is why space, time and their common measurability can appear as such in the first place.

The geometrical framework has already placed that very question behind itself in its initial assumptions.

21.5 When the Number Becomes the Mystery

The reversal becomes particularly evident wherever numbers achieve an almost awe-inspiring precision.

The speed of light links spatial and temporal measurements. Its exact value in SI units is determined through the definition of the metre, with the second already fixed. The value is therefore not an additional physical origin that first produces the light relation. It is a stable physical relation whose numerical representation receives an exactly stipulated value under this measurement order.

In Chapter 17 we examined the corresponding limiting reading of the *Tractatus*:

$$\mathbf{0|c \equiv 0|(\Delta\,|\div \Delta t)_{max}}$$

The light relation is not generated here by a decimal number written down afterwards. Rather, its determinate relational order is supposed to make intelligible the conditions under which spatial and temporal readings can be coupled and then expressed numerically.

It would therefore be a rather remarkable trick of justification to cite the fixed SI number as independent proof that the light relation must generate exactly that number from itself. We would first establish the standard and then let the standard confirm that we established it correctly. Excellent for a definition; rather modest as an ontological discovery.

Cosmology, however, gives us an example where the numerical value is not supplied by definition: the Hubble tension.

Different measuring and calibration chains, under their respective model assumptions, yield present-day Hubble values around 67 and 73 kilometres per second per megaparsec. These results are intended to determine the same parameter within a shared cosmological description. They do not agree within their stated uncertainties.

That is a genuine empirical difficulty. It does not disappear merely because we propose a philosophically more interesting question. Thus far, the Hubble tension seems distinctly unimpressed by elegant phrasing.

Precisely for that reason we must distinguish two difficulties. The divergence of measured values is an empirical problem not created simply by describing it. The broader mystery of why values measured as the *same* quantity must necessarily agree, however, depends on the shared model order within which we compare them. That order is not arbitrary, but its assumptions require justification and examination. Otherwise we risk declaring our chosen comparison scheme a property of reality, then blaming reality when it does not fit without further ado.

And still the tension makes visible a premise of particular importance to this investigation.

The measuring chains each have their own rules of comparison, calibrations and theoretical relations. To compare their results under the common sign H_0 is a meaningful and testable demand within the chosen cosmological model. But their common designation alone does not show that both chains already read out the same invariant relation under identical conditions.

The name of a quantity is not evidence that its measurement relations are identical.

We can therefore retain the physical question—why the values differ—while placing a more fundamental question beside it: what conditions must be satisfied for differently structured measurement orders to belong together as determinations of the same physical quantity?

Perhaps unidentified systematic errors exist. Perhaps model assumptions need revision. Perhaps cosmology requires an expanded description. The discrepancy itself decides none of these possibilities, nor is it explained simply by pointing out that the measuring chains differ.

What we can see is that coherence within one measurement order does not guarantee compatibility between different orders. Their common invariance must be determined and tested; it cannot be inferred from their shared symbol alone.

The number, then, is not the real mystery. The question concerns the relation under which we may expect two numbers to determine the same physical connection.

The point applies to other physical quantities determined through different procedures and subsequently treated as properties of one object. Comparability is an achievement of a measurement order, not a gift bestowed by a name.

21.6 Where Physics Undermines Its Own Question

We can now specify the accusation so immodestly raised by the title of this book.

One might be tempted to call physics an enormous edifice of lies. But that would not only be a somewhat unkind description of a science whose technical achievements we use every day with remarkable ease. It would also miss the actual error.

Physics need not lie to present us with a reality whose origin we misunderstand. It need not even get its calculations wrong.

After all, it is we ourselves who bring forth this reality in its particular modes of appearance through our measurements.

We distinguish, compare, delimit and determine. We develop apparatus that allows further differences to be registered, and we stabilise the results as recognisable objects, properties and quantities. Under these conditions a world of spatial bodies, moving particles, electromagnetic fields and temporal sequences appears to us. The apparatus does not arbitrarily decide what result it will deliver. But it belongs to the relation under which a particular result can appear as such in the first place.

Because this world of appearances functions with extraordinary reliability within its determined relations, we are tempted to

equate it with the original structure of reality. But what we have initially determined is its measurability and the forms in which it appears. It does not follow that those forms are also the core of things, independent of every distinction.

We confuse the reality that appears through our measurements with the prerequisite from which its appearance first emerges.

That is the real trick. And perhaps it is one we have mastered so well that we have long since forgotten performing it.

Recall the atom. We construct apparatus, determine recurrent relations under its measurement order and read them as atomic structure. Later, an atomic transition becomes a standard for further measurements. There is nothing technically wrong with that; we may stabilise a particular relation and use it as reference. But if we then declare the atomic order thus read out to be the unconditional origin of the very measurability under which it was first determined, we have reversed the direction of explanation.

We now explain our measurements through a mode of appearance that we brought forth through measurements. The procedure is precise. Its circular justification is no less circular for that.

The same confusion recurs at another level in wave–particle duality. We distinguish different registrations under different experimental arrangements, describe their distributions through different classical images and bring the results together within a common physical theory. Afterwards, we sometimes treat wave and particle as two originally present, mutually contradictory

properties of a finished thing. Then we ask, with immense seriousness, how that thing could be both at once.

Perhaps we have already constructed the difficulty through the images that were meant to make our measurements understandable. The success of quantum theory is not devalued by this; it shows precisely that different modes of appearance can be related under particular rules. But it does not oblige us to declare classical images two independently existing constituents of reality.

We have not necessarily discovered a contradictory thing. We may first create the contradiction by turning different modes of appearance into properties of a supposedly finished thing.

And then, naturally, we search for the error in physics.

Where else?

That we might already have produced it through the form of our question rarely seems the obvious possibility.

Space is no different. We determine different views of an object as spatial appearances belonging together and then explain their belonging-together through a three-dimensional body whose three-dimensionality we had just inferred from those views. We read the ordered relation of complete configurations as temporal continuation and then explain this continuation by a time already running in our explanation. Finally, we bring spatial and temporal measurements together in spacetime geometry and are tempted to turn that geometry into the independent substrate of the relations it previously made so successfully describable.

The error changes its appearance and scale. Its direction of justification remains the same.

Here we encounter a distinction more important to this polemic than any individual punchline. Measurement brings forth the particular *mode of appearance* of a relation; it does not create the universe at will. Different observers can compare results, discover errors and recognise stable relations again. That is why the readings are not arbitrary. Yet their stability does not imply that their objects, independently of the relations under which they are determined, have already been explained as original things.

Cut a surface and you obtain further surfaces. Investigate a body's appearance under other conditions of measurement and further determinate appearances emerge. Even atomic or subatomic description does not release us from distinction; it opens another order of readability. If we declare each new appearance the true interior of the previous one, we have merely moved the basic problem down another floor. The architecture of the error remains unchanged.

Physics can explain appearances through further determinate relations. A field is measured, a mass compared, an atomic transition recognised as recurrent order, a duration determined under a comparative rule. Such explanations are meaningful and may produce excellent predictions. But if we use those determined objects to explain the original possibility of their own determination, we replace the question of the operation by one of its results.

We must distinguish two forms of circularity. The problematic circle of justification conceals its premise. It treats a read-out

appearance as an independent cause of the measuring relation in which it became readable.

The *Tractatus Principio*, by contrast, places self-reference explicitly at the beginning:

Δ := |(|)

Difference distinguishes itself. Delta does not signify another apparatus, a hidden force or an even smaller object behind the particles. It denotes the operative reference of difference to its own distinction.

If we turned that into a mysterious substance sitting somewhere behind the universe and driving its remaining components, we would not have overcome the error. We would merely have given it an especially elegant symbol.

Difference is not the last thing we find behind things. It denotes the condition under which anything can appear to us as a thing at all.

Our criticism does not therefore claim wholesale that physics rests on a mistake. Many physical theories expressly take account of reference systems, apparatus and conditions of measurement. Mathematical coherence, technical success and independent tests are real achievements. None need be denied for our question to remain meaningful.

There is no need to fire the equations merely to check their jurisdiction.

The charge is directed instead at the unnoticed step that turns a particular, successful reading-out into an ontology without prerequisites. That step can indeed create riddles of our own: by

extending images beyond the conditions in which they apply; by ascribing to objects the origin of their own measurability; and by turning spacetime into something that is suddenly supposed to produce what we had first related under its geometry.

We do not create measurement results at will. But we can certainly create the problem we make out of them.

Not every open question in physics arises this way. The empirical Hubble tension remains a discrepancy to investigate even after we expose the assumptions of the measurement chains involved. But conceptual riddles created by confusing mode of appearance with origin do not become more fundamental merely because we seek ever more precise answers to a question wrongly framed.

Perhaps physics does stand atop a vast structure of premises whose original connection it does not always examine. The disquieting thing is not that the building must collapse at the next measurement. The disquieting thing is how brilliantly it works while we mistake its storeys for the ground on which it stands.

We measure ourselves a world, declare its appearances the causes of their own possibility of appearing, and then marvel at the riddles we thereby create.

Not every difficulty is our own work. But wherever we confuse a reading-out with its origin, we have at least contributed to the mystery.

And perhaps, before accusing the universe yet again of behaving contradictorily, we should investigate the distinctions under which we have made it appear that way to us.

21.7 Archibald Asks a Different Question

Let us return one last time to the beginning.

Archibald lands on a planet whose inhabitants are two-dimensional. He views their world from his supposedly self-evident three-dimensionality and wonders how they can live without the spatial depth he regards as the prerequisite of any reasonable existence.

He overlooks one small detail.

He is a cartoon character himself.

His dog is a cartoon character. His spaceship is a cartoon character. And the entire universe in which he parades his superior three-dimensionality fits onto a two-dimensional picture surface.

You would think that by now Archibald might have reason to present his geometrical certainty a little less confidently.

That is the real comedy of the scene. Archibald has declared the alien world's two-dimensionality a problem because he brought his own three-dimensionality along as the original standard. The problem is not initially with the inhabitants. It is with the question he asks them. He has taken a particular spatial reading as a premise and is now astonished that another world refuses to conform to it.

A remarkably elaborate mystery for someone living on a picture surface himself.

But are we really in a better position?

We look at a table and explain its different views through presupposed spatial depth. We experience motion and explain it through a time already running. We measure light under spatial and temporal rules of comparison and sometimes treat its stabilised numerical values as though they had first generated those relations.

We alter experimental arrangements and still expect to find the unchanged appearance of an object supposedly determined in full independently of the experiment. We infer astronomical distances and past light configurations, order them within a common cosmological geometry, and are tempted to regard that geometry as the original substrate of all measured relations.

Yet every such investigation already begins with the same fundamental position:

A|B

Not two finished things, but the poles of a distinction.

And that distinction can refer to its own operation:

Δ := |(|)

Under its polar reading, observer and world appear. Under its geometrical reading, positions, surfaces and spatial depths become determinable. Its directed, coherent continuation is read as motion and time. Under stabilised rules of comparison we obtain numbers and physical measures. Technical extensions of the observer relation open further registrations, which we determine as atomic structures, particles, fields or astronomical opposing poles. And the common geometrical order of such measurements finally becomes readable as spacetime.

None of this is arbitrary. Nor may the *Tractatus* simply assert the stability and mutual compatibility of these readings. It has to make them intelligible within their respective relations.

For the coherence of complete relational configurations we wrote:

|Σ = ((|_|₁|_|₂) ⇔ (|_|₂|_|₁))

And for the invariance of observer continuation:

O Δ O

The world described in this way is no arbitrary invention of Archibald's. A measurement can confirm or contradict his expectations. Different observers can compare results, correct readings and rediscover stable relations. Precisely these possibilities show why the order of difference must not be confused with an individual's passing fancy.

But the world emerging under these measurements as the object of our knowledge is not thereby the original connection itself. We bring forth its particular mode of appearance under the distinctions we choose. That those modes are compatible and reliably measurable does not yet explain why we are entitled to treat them as original things existing independently of the operation that produces their appearance.

Perhaps, then, the real point of our inquiry is not that we have found a new cause behind the causes familiar to physics. Another cause would again be a determinate object of explanation, and we would immediately find ourselves on the next lap of a journey we thought had ended.

The point is that we finally pay attention to the direction of the question. **We do not merely measure properties of a finished**

world found waiting for us; through our measurements we determine the form in which it appears to us as a world at all. And if we subsequently declare those modes of appearance their own independent causes, we can create mysteries arising not from a stubborn reality but from our way of questioning it.

The fact that a question can be pursued scientifically does not make its premise necessary. One can work with great precision on solving a problem generated by one's own language. Precision is not the problem. Unfortunately, it does not automatically protect us from the error installed at the beginning.

Not: Which still smaller object hides behind the next surface?

But: Under what relation does something appear to us as a surface, an object, or as spatially or temporally determinate at all?

Archibald need not first marvel at how two-dimensional inhabitants can live without his third dimension. He should ask what makes their world appear two-dimensional to him in the first place. Perhaps he would then notice that even his own spatial self-evidence has a perspective.

The same applies to us. We need not abandon physics to ask this question. Physics itself supplies the evidence of its practice: it measures differences, compares relations, stabilises recurrence and examines how registrations can be brought together under common rules.

It must simply be allowed to ask about the conditions of that very activity.

It is not the relation that must justify itself before a physical description, as though that description arose independently of all relations. The description must show under which relations its own concepts become determinable in the first place.

The *Tractatus Principio* thus leads us not to some final object hidden behind reality but back to what we already enact in every new determination—and what we most easily overlook precisely when a determination succeeds particularly well.

Perhaps physics might have been spared some of its self-created riddles had it distinguished more clearly between the original difference, the modes of appearance brought forth under measurements and the concepts through which it describes those appearances. Not every problem would disappear. But at least we would no longer demand that reality reconcile our own pictures for us—or search for the core of things where we have just determined their next surface.

Archibald looks at his world once more. Perhaps he examines the table, perhaps the star, perhaps only the surface of his own cartoon existence. For the first time he does not ask what might be hiding behind the next surface.

He asks what he is doing when he recognises something as a surface at all.

Our journey ends where it began. Not with a thing, not with a number, and not with a particularly impressive four-dimensional container.

But with a difference:



And with a question that might have spared us a good deal had we asked it sooner:

What am I actually distinguishing when I believe I am explaining the world?

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