

TRAILS

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IMPRESSUM

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INTRODUCTION

This book is a summary of a paper about the phenomenon of human walking.

Since 1990 we have studied the phenomena of human walking as part of a special research group of the University of Stuttgart on the topic Natural Structures funded by a grant from the DFG (German Research Fellowship).

The research group was initiated by Frei Otto in 1985. The observations and understanding of human walking and the collected pictures have unfortunately remained unpublished until now. Anette Gangler and Jörg Esefeld gave the impetus to take up the topic which was almost lost. It was a cordial gift to me for my 75th birthday (German version).

The book is a record of observations. It cannot and does not intend to be a classic research book. The study elucidates the phenomena of walking step-by-step, which we can only learn by the analysis of our own behavior and that of the people who move around us. Most parts of the book are the results of in-depth self-observation. The advantage of this summary is that every attentive reader can easily follow the reported observations himself / herself. It is, thus, a chance for the individual to understand himself and others in their constant movements.

The structure of this book gives an account of the fascinating process of realization which I had. Most of the pictures are my own photographs of beaten paths found all over the world. All pictures contribute vital information to our battery of questions.

Beaten paths show the unaltered programs of human perambulation traced in the dirt. They declare a specific form to the careful observer who can read the tracks. What appears to be so inexact, sporadic, and haphazard actually follows very logical and understandable rules. Unlocking the readability of the phenomenon of beaten paths is an important aim of this book.

The structure of the book has the following outline. First, the impulses for the key observations of our walking behavior are presented. The next question always arises after observations of the tracks.

In the second half, the morphology of the dirt paths is more closely analyzed and verification is sought for the proposed theses.

The third part studies the various types of walking and reasons for them.

The final chapter attempts to apply this theoretical knowledge to actual problems and to attain new insights.

I had the advantage that most of the themes and commentary of nearly all that was illustrated and reported is already familiar to the reader. The pictures of the paths have their own particular beauty. The internal logic and the often rigid assertiveness of these self-made structures show that no small powers are at work here. My intention is to enable the reader, like the author did, to make similarly fascinating discoveries.



The Beaten Path

Tracks of Man and Beast

In the following work, the beaten path is like a readable program which forms the most important source of information for questions about the patterns of walking.

It is common to both man and many animals to prefer the use of a trail upon which they have once traveled. Depending on the frequency of use, a lightly or deeply beaten dirt path emerges.

A great similarity is seen in dirt paths all over the world. The trails reveal that the various forms are often completely identical. Many animal trails, especially those of cattle, are almost indistinguishable from those of people. A quirky, oscillatory wavy line always forms the basic pattern. A basic behavioral scheme seems to be expressed in the trails. Then I applied my curiosity and observations to the phenomenon of walking. In the following chapter an initial experiment is described to learn more about the forces and motives which produce an apparently similar form.

■■■ Dirt Path in Namibia (zebra or gazelle)

■■■ Dirt Path in Cracow as a Short-cut



THE FIELD EXPERIMENT



Straight Track in a Field of Snow

A walking experiment was conducted completely without apparatus or helpers on a field of snow. A snowy winter offered a continuous field for research and allowed the repeated replication of the experiment. A track was trodden as straight as possible on an untouched snowfield.

The chosen test stretch A-B was a distance of approximately 300 meters and the ending point could be easily seen from the starting point A. The walker homed in on the goal with great concentration and tried to create a path as straight as possible. Because the test field's location was directly below a steep slope, the subsequent documentation of the track was easily accomplished from above on the slope. By intention, a simple test was initially chosen.

The result is quite clear-cut and was replicated multiple times with the same result. Despite the walker's intense concentration, a straight path could not be produced.

Almost to my disappointment, not even a reasonably straight line was made. Instead, there was a path which swung back and forth around an ideal axis. A better result was obtained when a telephone pole was honed in on halfway down the stretch of path. That means that the more distant the goal, the greater the deviations from the ideal line. With the exception of some narrow ditches which were always crossed perpendicularly, the walking track was not blocked by any obstacles.

Discovery of the Navigation Program – Viewing Field Intervals

During the walking experiments described above, a new and interesting observation is made. The walker's self-analysis reveals an unexpected behavior on the traveled stretch. It is sight which steers the direction of walking. The walker generates a track as straight as possible. The stated aim is to keep the path straight.

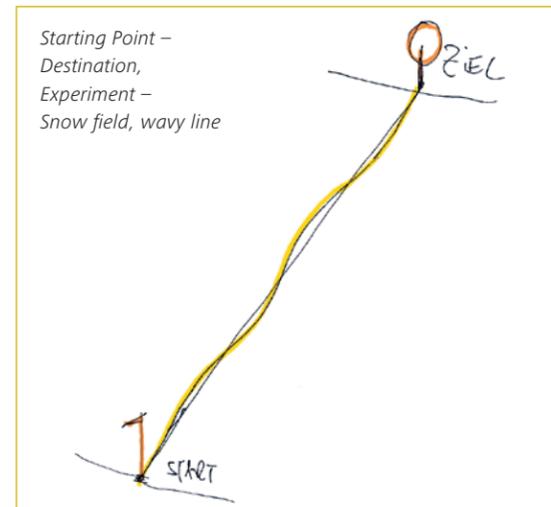
When the walker carefully observes himself during this activity, a particular behavior becomes evident. In order to reach the destination in the most direct way, we focus our eyes alternately on two different areas of the stretch. In the first field of vision (Field of Vision I), the eyes are set upon the objective in the distance toward which he walks. In the second field of vision (Field of Vision II), the foreground of five to eight meters directly in front of the walker is surveyed. During the activity our gaze constantly alternates between these two fields of vision.

To our surprise, the experiment showed that we devote a much greater amount of attention to surveying the close range. Measurements of the time intervals show that the walker glances only very briefly at the long term objective – approximately once every 10 to 15 seconds. During the remaining time his gaze is occupied with watching the vicinity of his feet. That means that the proportionate lengths of both observation intervals is about 1:10.

On the smooth expanse of snow there were no surprises or obstacles. Why does this continual, compulsive close-up inspection happen? A mere glance suffices for the distance observation to locate the objective. The same results are produced when the experiment is repeated.



■■■ Test stretch with two lines of tracks:
 Perpendicular Crossing of the Creeks Clearly Visible



■■■ Test Stretch /
 Length ca. 300 Meters



■■■ Purposely Produced Tracks:
 Tracks Trodden Multiple Times

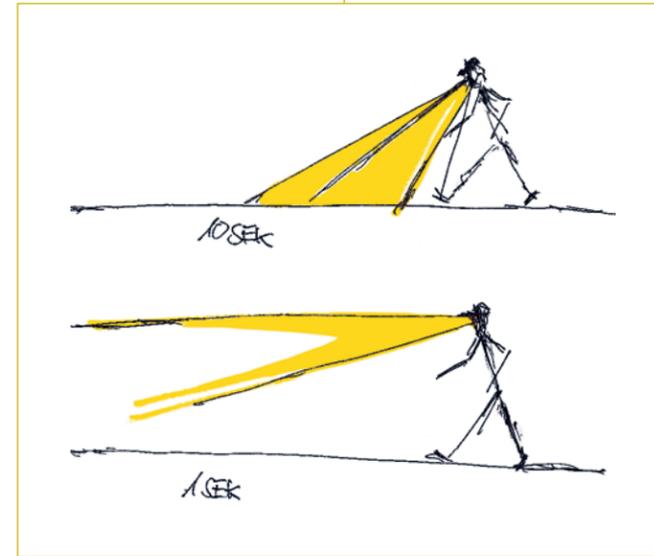
Manipulation of the Duration of Vision Intervals

The observer was extremely curious to learn if there is a general rule for the discovery of vision intervals and their differing lengths.

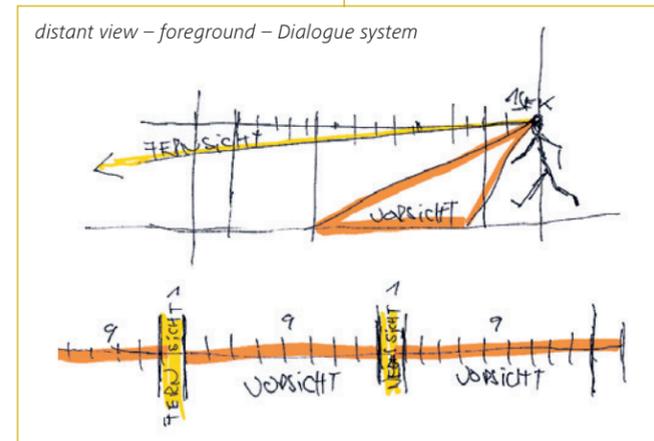
The continual pendulum movements of the gaze between the distant navigation (Field of Vision I) and the cautious inspection of the ground in front of him (Vision Field II) was further confirmed by a small experiment. The parameters were changed with a small ploy:

The walker forced himself not to alternate his gaze, and instead, held it rigidly either on the distant point or on the ground. This inner command is easily given and is also maintained for a short time. Thereafter, only extreme effort enables one to persist in this manner for more than a short time. A strange uneasiness grips the walker, which could almost be called stressful. The body "begs" the will to allow a return to the alternating gaze. As soon as this is again allowed, a pleasant relief sets in. It is practically impossible to traverse the test stretch with the gaze fixed on the goal alone.

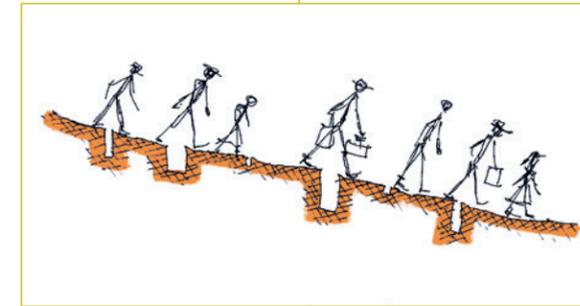
The experiment shows that the careful perusal of the immediate foreground and its continuation is clearly a very important and necessary pattern of behavior.



Walker with Fields of Vision



Vision Segments



Sketch of the obstacle course in Istanbul



Obstacle course in Magdeburg: Pedestrians confidently find the dry path between the many large puddles

Monitoring the Foreground

An Example – observed in Istanbul: A path strewn with obstacles

I was able to observe a perfect example of foreground monitoring and our virtuosic ability to navigate in the foreground in Istanbul:

The city was preparing a new pedestrian area. A slightly sloping, thick concrete slab which spanned the entire street was used as a base. Cut into the slab were numerous sharp-edged gaps which varied in size from 30 by 30 to 80 by 80 centimeters, with depths varying between 50 and 150 centimeters. In Germany such a construction site would be inaccessible to the public. Yet, in Istanbul, a steady stream of pedestrians made its way across the obstacle course. The stream of pedestrians prevented a good overview of the area. For this reason, people were not able to avoid the various holes in the pavement in time. Despite this fact, people traversed the area at a quick pace, often laden with parcels and engaged in lively conversations, without any apparent concern for the dangerous obstacles in their way. The ground surface was always under observation, and the safe path was instantly chosen.

An example – observed in Magdeburg: Wet pathways

In Magdeburg I was able to observe a very similar situation:

The pedestrians likewise boldly overcame a similar obstacle course. The obstacles in this case were large, deep puddles that dotted a narrow, highly trafficked pathway. The pedestrians exhibited the same virtuosity in avoiding the puddles. I observed the stream of pedestrians for quite a while and not one got wet.

Monitoring Program for the Foreground

The walking experiments which used a straight path with no obstacles proved that we require significantly more time for monitoring the foreground than we do for the distance navigation. From the observations of the confident mastery of obstacle courses by pedestrians, we may apparently conclude that human beings possess an extraordinarily well coordinated observation and reaction program for this area.

The question: "Where can I step?" is self-evident for the barefoot walker. When we bear in mind how and where man lived for the longest portion of human development, then the concern for the bare foot is understandable, as demonstrated by shoes and the construction of smooth pathways for the protection of the feet.

Up to now, the walker has been the focus of all observations. The instantaneous reaction observed on the pathways with obstacles in Istanbul and in Magdeburg is also quite common with mountain climbers and skiers cases. In these cases, instantaneous coordination between eyes and limbs is a matter of necessity.

We find this reaction also with drivers. Observations on the roadway show a very similar switching of gaze between the foreground and long distance views. In the case of roadways, we are usually traveling on completely smooth surfaces, so that inspecting the foreground is less imperative. Instead, instruments and mirrors must be monitored. The internal denial of the switching movement between near and far fields of view, which the experiment in the snow field had shown, leads to a similar result even under the completely different circumstances of driving.

NAVIGATION

Test Field: Pathway in Stuttgart's City Garden

Navigation with Adjustments

The former city garden of the university campus in Stuttgart offers a further field for investigation. Analysis of a trodden path there provided remarkable information. A narrow pathway ran a very logical course and made up an advantageous shortcut between the collegial buildings of the university and those of the technical college. The official walkway offered the connection only with a circuitous route.

There was a peculiar feature to the route of the dirt path. In the second third of it, in the southerly direction, there was a definite kink in the course of the trail. In formulating a reason for this kink, the following thesis was quickly developed:

Approaching from the north, the goal, a passageway between some trees, was easily spotted by the pedestrian, who, at first, sets out for this goal. However, after crossing about a third of the way, a flat flowerbed is seen on the longer pathway which was not yet visible from the greater distance. In order to avoid trampling though the flowerbed, the pedestrian immediately adjusted his course to bear slightly to the left of it.

Thus, the kink in the pathway represents an adjustment to the original course which allows the pedestrian to make the necessary correction and still attain the goal without greatly lengthening the walk by making many turns.

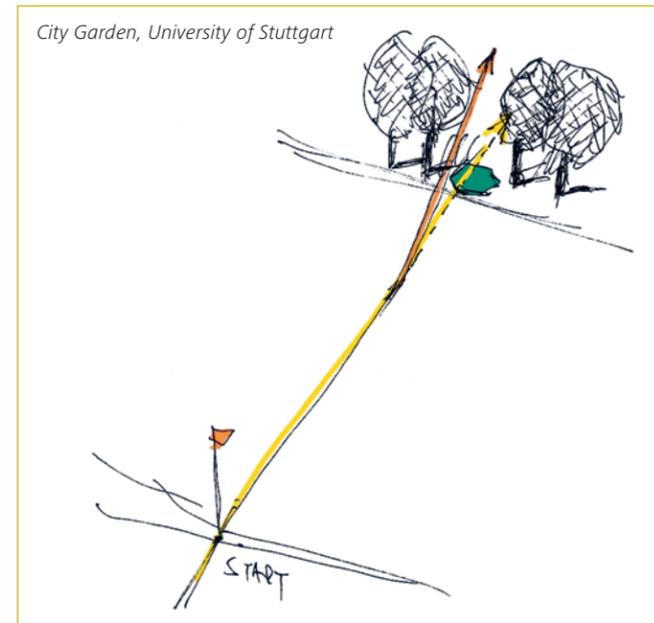
These observations about path finding provide an important key to further concepts regarding navigation.

By good fortune, the example of the trodden path in the city garden provided us with yet another confirmation of our theses.

One summer, the city of Stuttgart allowed a little circus to be erected on the lawn through which the pathway ran. After it was taken down, the grass was quite trodden down and the field needed to be plowed up and reseeded. I anxiously awaited the

formation of the new path. The line of the new pathway followed exactly the same course and had the same kink at exactly the same location. Photographs of the old and new pathways show no differentiation, and thereby neatly demonstrate the sensitive navigation program associated with our walking. This clearly demonstrates that we choose our path exactly and not at all by accident.

Walking on this path, I came to understand the important role played by forward looking vision. Unfortunately, further evolution of this path is no longer possible. The landscapers, natural enemies of unrestricted walking, constructed a permanent, paved walkway.



Overview of the alignment of the shortcut



The deviation of the path direction and the threading of the path through the small opening between the flowerbeds



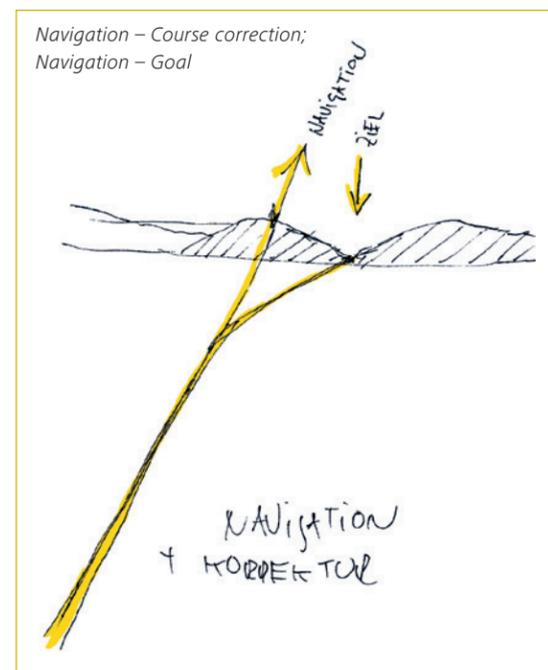
Location of the course correction of the path



The field is plowed up and is reseeded



■■■ The reappearance of the path with its kink



■■■ A sketch showing a distant point in the landscape

Navigation towards a Destination

The two behavioral modes, foreground monitoring and navigation toward distant points, are important elements of our ability to travel along a path.

Discovering both the navigation goal and the associated adjustment is possible using many beaten paths. There are wonderful beaten paths that make the dialogue with their goal clear through their route. For example, in older cross county paths, certain geographic features serve as the distant goal because they are readily sighted from a great distance. These paths then require adjustments as one comes in the proximity of the goal, such as we observed in the city garden. In Freiburg, for example, the elevated prow of the widely visible Schlossberg fortress serves as a prominent landmark for many highways that signal the entrance to the crossing through the Black Forest. Apparently, such widely visible pointers simplify our navigation on foot.

Navigation as an Internal Dialogue “How do we find our way?”

How does one plan, choose, decide, and find his way to a chosen destination on foot? In this section, we will try to understand the process of path finding and how we decide on a route. We have already found out some things concerning navigation. For the pedestrian, there are various determining factors. Is he in familiar or unfamiliar surroundings? Is he in the open country or in the grid of a city? Is it light or dark? Are there obstacles or difficulties to be taken into account, such as wet ground or steep grades? And does the pedestrian have a clear goal?

In the following observations, I assume that the pedestrian is finding his way through an unfamiliar region.

Our pedestrian has a clear destination. He will need elevated attentiveness moving through an unfamiliar region of a city or open countryside. This scenario is based on personal experience and can be readily imagined by the reader. In this self-inspection, we determined that,

in walking through an unfamiliar area, we needed to continually decide between different alternatives in order to find the way.

A continual internal dialogue takes place. In a question and answer format, the most promising route is chosen. This procedure occurs in a fully automatic way and one does not consciously articulate it. This questioning is almost always structured in a similar way. The first voice makes a suggestion for a course of action. The critical second voice has reservations or suggests an alternative. The first voice replies with an assertion why the proposed alternative is either better or worse. In considering the options, a decision is made for one route or the other.

Most often, the arguments in such a dialogue are considerations for a shortening of the way. However, arguments might be made for a more comfortable route, for example, less steep, or not so sunny, or protected from wind and rain. Moreover, a picturesque view or some other attraction, for example, a display window, might be an argument for choosing a certain way.

If we are walking at night, then other important safety criteria, like a clear view of the pathway, are added to the mix.

Almost always, the suggestions are arguments that promise some advantage for the subject at hand. This question and answer routine takes place in principle with every type of locomotion, regardless if it be on foot, by car, or by bike. Just the simple act of looking for a parking space is enough to prompt the question and answer routine. In city traffic, the question comes up immediately – what is the best route? The automobile introduces a new optimization factor – speed. The trip will now be optimized. Now, the objective is not simply the shortest path, but, rather, the quickest route. However, for the pedestrian, the shortest way is also the fastest. Today, as ever, this argument is one of the strongest.

The methods of navigation are the same for different means of locomotion and, in the following text, the attempt will be made to illuminate the rules of navigation which have been discovered.

Path finding – Diversity of Behavior in Seeking Routes

Routine paths

If our destination, in a routine manner, leads to a commonly used path, there is no more need for the question and answer procedure. The optimized way is already known and we move almost as if on rails. This comfortable variation speaks to our tendency to minimize complexity. It can be found to be pleasant, relaxing, but also boring. In the end, all streets and pathway networks facilitate comfort. They make many decisions concerning the route superfluous. But, despite this perfected network, navigation and path finding are apparently still fraught with exertion. The aim of the electronic navigation system is to ease this labor. A friendly voice from the device replaces, for the most part, the previously described dialogue.

Path finding in familiar surroundings

In comparison to the routine paths, this situation corresponds more to a planning procedure. We have the entire spatial situation before our eyes and consider only which of the many possibilities we should choose. Very often, the route is only decided just before we start. The effort of searching requires more attention.

Path finding in unfamiliar surroundings

This section was previously described in the section explaining the phenomenon of the dialogue. If we should find ourselves in this situation without the aid of a map, the search for the way can be tedious work. It is again accompanied by stressful doubts. This taxes the pedestrian as well as the driver. This is made apparent by the onset of irritability. A few of the ubiquitous standard questions will bring this situation immediately to mind for everyone:

Which way next? Is that the right way? Something's not right here. I'm lost. Should I turn around? I've

made a wrong turn. That's out of my way. Here is a shortcut. That looks familiar. I've been here before. I should be over there. OK, now I'm back on track.

The way is lost.

We experience a bit of drama when we can no longer find the track. We have, at that instant, “lost our way”. Now the internal dialogue is racing and fellow travelers will notice the testiness of the seeker. If the internal interrogation about the route brings no solution, then we are quickly to the point of turning toward other people, from whom, as a rule, we receive helpful information. To ask for directions would seem to be one of the ancient forms of straight forward communication. Interesting in relation to this is the phenomena that the questioned passer-by indicates the distance to the sought after location by the height of the raised hand. The higher the pointing finger, the farther away the destination is.

Lost

We experience the most intense form of emotional involvement when we are really lost. This is a situation that is totally unknown for many people nowadays. Stress, even to the point of panic, is the result. Whoever is a first rate, experienced path finder is given the special name of scout. His counterpart at sea, the ship's pilot, holds to this day an indispensable position. The mountain guide also belongs to this group of path finding specialists. All three are held in high esteem and their followers obey their every command without question.

On the basis of these different idealized examples, the postulated program of question and answer dialogue must be further clarified. Even in looking for a parking space, our route is entirely oriented to the task first of finding a spot, and then, if possible, a well placed spot.

We realize that path finding in an unknown terrain always requires a great effort. For this reason, it is not at all surprising that, as a rule, we prefer the

“pathways” already drawn out and freed of obstacles. If we are walking cross country through woods, we rejoice over each, be it ever so small, path. On a trodden trail, everything is simpler and our searching program is more relaxed. Animals as well prefer to follow a well-trodden trail.

Verbatim logs

With the verbal log, individual movements and driving decisions are recorded. The attempt is made to document in words the activity of human locomotion in terms of a search procedure in our thought process. Whether on foot or in a vehicle, the verbatim log has the character of talking to one's self, and therefore can reveal the very complex mental process only in a very limited way.

Yield – there's someone to the right at the side – should I pass here – completely blocked – someone coming from behind – now it's possible – he's pulling in front of them – a motorcycle from behind – let him get by – pretty hot – overpass Sindelfingen/Böblingen, beastly traffic – the Mercedes folks are really coming along with their building construction – the street – it seems to wind around – they're spewing a good bit of smoke over there – tired – should I stop at the gas station to pick up something – a bit faster, the guy behind me is tailgating – into this gap – a bit of fresh air – let the hot air out – I'll have to stop in 1000 m – 300 m – 200 m – maybe next time – so bright – do I have my sunglasses on – oh boy, a trailer – a tunnel – dark – blinding – looks like we're going downhill – Herrenberg 1000 m – look out: two helicopters – you can see the highway behind you – shade from the clouds – can still see that helicopter – car crossing the street – tired – Rottenburg on the Neckar – flashing light – if shade would only come, ... – those 3 hours of sleep last night were just not enough – at the next parking lot I'll just take a little nap – missed that parking space – 80 m – one/two pylons here – tractor on the bridge – one lane – this one way stretch goes on forever – I've never noticed that little house in the

field before – someone's running over there – they're broke down – that grill on the roof really looks pretty good – the green weed is blooming already – ... – surprising that there are chestnuts here – should I get off at the Oberndorf exit or in Rottweil? – actually I would like to get on to that Roman road in Rottweil – I don't know exactly where it is – its not on my map – thank goodness, I'm not so tired anymore – there's another one – what's going on with these tires today – perhaps the heat – man, that tractor is kicking up the dust – it has certainly rained enough – how the lines keep on running – a buzzard – I've never really noticed that quarry – the Rottweil rest stop, now I'll get some candy – what's lying around here – sheep on the highway – but there's a good fence there – the yellow canola plant is nice – an opening – left to exit – 1000 m to the rest stop – another buzzard – I'm driving up as a shadow – that won't work – shall I get something to eat ...

A break in the log / pause between 2:50 to 3:00 pm

I don't know this stretch – I'm looking now for a route and a traffic system, which Mr. Birk presented to us last Wednesday in the evening class – I also don't have a map, so I'll have to find this route from memory – crazy speeders – waving out of the car – they're feet – everything's in bloom, as one sees by the trees – will I find this street – have they been eating into the canola field – Rottweil 1000 m – I have to get off here – it's called the road to Zimmern, the old road to Zimmern – everything is mown – Rottweil – nice, the way the carnations and daisies are blooming there – aha, the hill that Mr. Birk mentioned is over there – the street goes directly up to the hill – down there it runs right on through – I have to pull over to the right, then I'll get to it – I can't get down there from here – no, it is useless – get down there – I'll turn off here – 80 m – there is the water tower – absolutely no connection – here off to the right, Zimmer o.R. – that o.R. must mean above Rottweil – it looks like the old road coincides with the federal highway, here is the Heerstraße, now the chapel should be coming up – OK, there it was –



no, that's not it – it's a small village by itself – the old road, that was certainly a hospital – I'll have to turn around – I always enter here at this point – oh, Zimmern was the place we just now passed, got to go back again, thread my way through once again from the back – there's a fork in the road, now this street comes, but I've come too far out – here is the village center – straight ahead to Rottweil – now that hospital should appear – ugly boxes there – OK, that appears to be the hospital – there used to be houses with red roofs – something's not right – oh, this is all wrong here – that is it over to the right – that is the sign he showed – a construction sign – everything is mixed-up – but he did show those houses – so, where is that chapel – OK, there it is – now I should come to the dirt path – there is part of a walkway that is going through – now the hill is in sight – pull over again – this is the old trail here – it's uphill now – the ridgeway is over there . . . the end of the line - now the real work begins.

■■■ Pseudo goal: The artist placed his gateway over the path of the shortcut after the fact

■■■ Shortcut through the park in Freiburg:
The portal in the garden hose sculpture by Claes Oldenburg is the destination headed for which can be seen at some distance.

