SCIENCE FORUM

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'Anthroposophy' is the name that Rudolf Steiner (1861–1925) gave to his Science of the Spirit. This has given birth to new perspectives and practical activities in the arts and sciences, in medicine, agriculture and education. Information on Anthroposophy and the Anthroposophical Society can be obtained from Rudolf Steiner House.

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Editorial

What is science? Oh no, not that one again!

The 'man in the street' (whoever he is) can be forgiven for thinking that 'scientific facts' are true and proven; reliable: that they lead to predictable results; that they are always reproducible. After all, a car or video that was not built according to proven, reliable, predictable, reproducible scientific principles would be a pathetic object indeed. The qualities we look for in our technological products we naturally assume to be present in the underpinning scientific principles. And why not?

The biological phenomenon of 'variation' would be a most unwelcome intrusion into our technology. It is just when *life* comes into the picture that our belief in uniform predictability begins to waver. The application of rigourous technological thinking to real living human beings, can let us down.

Take, for example, three of the most objective, apparently unassailable techniques used in the forensic field: fingerprinting, DNA analysis, and video evidence. A recent television programme (*Equinox*, Channel 4, 28th December 1994) revealed cases where convictions based on such evidence were quashed in the light of further facts.

Video evidence would appear, on the face of it, incontrovertible. In fact picture quality is often poor, so rather than direct recognition, one has to rely on matching characteristic parameters, such as a particular defined nose-to-forehead distance. Unfortunately these parameters vary with the viewing angle, so mismatches and consequent false convictions have resulted.

Such is our belief in the quality of fingerprint evidence that one man was convicted on a single print alone, despite not being recognised by the victim he allegedly attacked. The objective evidence of a scientific test prevailed over the subjective evidence of a shaken victim. Yet later on the true perpetrator came to light—the *true* owner of the fingerprint. The police involved were stunned to discover that the fine human judgement involved in matching the fine features of fingerprints can lead to such an 'error.'

Finally, the 'holy grail' of forensic science: DNA profiling. The claim that this provides a unique individual identifier was put to the test by sending samples for matching and comparison to a leading laboratory. Some correct matches were made, some were missed, and some mismatches were made. In one random sample of 30 patterns, a 12-band match (i.e., a very high probability) was found between two totally unrelated people, one of whom was a member of an Amazonian tribe! It appears that the pattern of bands may not be as unique as claimed. Also the whole process involves around 50 stages, giving some scope for errors such as cross-contamination.

The 'objectivity of science' is on the line here. These methods are *not* infallible. As one person in the programme so eloquently put it: "any method devised by humans can be screwed up by humans!"

What lesson emerges from this? Whenever science becomes a tool of authority—be vigilant! Facts are facts, but interpretations aren't. Part of the scientific spirit is to question, no matter what the experts may say. This spirit is admirably illustrated in the book *The Facts of Life*, reviewed in this issue. The author accepts the palaeontological and other 'facts,' but not their interpretations into Darwinism. Darwinian theory, fingerprinting, DNA profiling and much more that we hold to be 'scientific'—they are all clearly *based* on observations, generalisations, experimental facts, laws, etcetera. But we need to be clear just where the irreducible facts end and the speculation begins.

Back to the question, "What is science?" My science teacher of nearly 40 years ago was quite clear: "Science is truth," he told us. Preferable to my dictionary, which tells me that it is 'an organised body of knowledge,' and that 'knowledge' is 'theoretical or practical understanding,' and that 'understanding' is 'power of apprehension,' and that 'apprehension' is 'power of understanding.' (Where did I go wrong?) In other words, 'Science' is one of those words, hard to define, with a range of meanings. And within the materialistic paradigms which dominate the twentieth century, 'science' has become a word of power, an instrument of authority. If it's 'scientific' we can't question it!

Yet we must learn to recognise fallible human judgements and opinions in the very fabric of our science. The wider interpretations of phenomena which we aim to examine in *Science Forum* are only possible when the *human* element finds its rightful place in science.

Howard Smith

Revolution in Evolution

R.J. Gilson

During the last century, the Darwinian theory of evolution by the automatic adoption or 'natural selection' of any reproductive variations that happen to confer any slight advantage on the progeny has become the corner-stone of our Western education system. The religious implication of this state of affairs was epitomised by Sir Julian Huxley when he declared on television in 1959, "Darwinism removed the whole idea of God as the Creator of organisms, from the sphere of rational discussion."

In replacing the religious concept of a creative source by the materialistic concept of evolution by a process of accumulating random variations over immense periods of geological time, Darwinism has become a major factor — some might say *the* major factor — in the erosion of moral values in our times. Sir John Eccles has summed it up succinctly: "Value systems that have been built up over hundreds of years are now deteriorating so that society is threatened by newly developing barbarism. Crime of all kinds... is increasing at an alarming rate. The prison population is growing as never before. While there is so much public interest in the prevention of nuclear war, there is lamentably little interest in the destruction of society from within by the failure of our system of values."

None of this thinking is new, and many before me have endeavoured to draw attention to the fallacies inhering in Darwinism. But these rash dissidents have got nowhere, for the simple reason that, as biologist Garrett Hardin has commented, Evolutionists have become so deeply committed to their beloved theory that their first reaction to any criticism of the theory is to question the sanity of the dissident.

However, a change may be pending. The attached paper, with Introduction by the distinguished scientist Professor Ervin Laszlo, presents a factual mathematical analysis demonstrating quite clearly that evolution by the gradual accumulation of *random* variations cannot provide a credible explanation of all the complex biological structures found in nature.

The history of this paper to date affords a striking example of the insuperable difficulty of obtaining any objective consideration of heretical views of evolution, however striking they may be. The paper was submitted for comment to a dozen mainstream scientists, mainly professors and editors of scientific journals, and with two exceptions they all rejected it off-hand with no real thought. The exceptions were the editor of *Science Forum* and Professor Ervin Laszlo, who generously provided the constructive Introduction appended. It is interesting to glance at the excuses put forward by the remainder. These can briefly be summarised as:

1. The paper is unscientific because of its *de novo* argument and the consequent absence of specific examples.
2. The argument is based on *ab initio* probability calculations.
3. The fallacy in the argument is the assumed determinism of the interacting structure discussed.
4. The argument is a mere rehash of the old chestnut that because living things are inherently improbable, they cannot have evolved.
5. It is a fallacy to think in terms of linear series of progressive variations.
6. One cautious editor confined himself to saying that he disagreed with the paper, but did not have time to explain why.

These evasions seem to me mere off-hand excuses for not giving serious thought to the points raised in the paper. I suggest they can be considered as a sort of mental 'knee-jerk' reaction, based on the unshakable belief that since everybody *knows* evolution is established truth, it follows that any dissenting view *must* be wrong. But so far, nobody has been able to point to a logical flaw in the argument put forward in the paper.

An Introductory Note to R.J. Gilson's "Fundamental Flaw in Evolutionary Theory"

Ervin Laszlo, April 1994

Gilson has produced remarkable, and I believe entirely convincing, evidence against the random-mutation argument as a sufficient explanation of the observed evolution of species. He has shown that even repeated trials cannot significantly increase the chances that complex organisms, such as those we see today, should have emerged in the biosphere within the available time-frames.

His views are entirely consonant with mine (see Chapter 5 of *The Creative Cosmos*, Edinburgh, 1993). Where we diverge is regarding the interpretation of our findings.

Clearly, as I noted — and I believe Gilson would agree with me — something fundamental remains to be discovered about form-generating processes in biology. The question is, where shall we look for that additional factor? Gilson looks for it beyond the natural world, in the workings of an intelligence superior to any possible human intelligence. I look for it within the natural world, as a self-referential dynamics based on a scalar holographic field, introducing a self-consistency bias into seemingly chance genetical mutations and thereby reducing the time required for those mutations to build coherent phenotypes.

At first glance, a scalar holographic field generated within the cosmic vacuum and the workings of a supernatural intelligence seem widely different and perhaps even mutually exclusive concepts. Yet a deeper analysis will not support this impression. Who is to say what the ultimate nature of the basic realities of the universe are truly like? Could not the universe, with all its evident self-creativity, be the product of a cosmic mind or consciousness? All we can do is look for the results of the stupendous self-organising process we know as cosmic and biospheric evolution; the originating forces behind it must remain forever shrouded from our eyes — our scientific eyes, that is. For in questions such as these we enter the domain of mysticism and theology — no less important than the sciences, but fundamentally distinct from them.

These observations do not detract from Gilson's major achievement: to show us in a decisive, and it would seem to me irrefutable, fashion that chance could not have been the principal factor in biological evolution. The search for the "missing factor" should now get seriously underway — both within the natural world that is the domain of science, and in the transcendental realm that is the province of spiritual inquiry and experience.

A Fundamental Flaw in Evolutionary Theory?

R.J. Gilson, C.Eng., MIMechE.

One of the cherished tenets of Darwinian evolutionary theory is that the evolution of biological structures takes place by the accumulation of a multiplicity of tiny intermediate steps, in contrast to the alternative of a single giant step. So ubiquitous is this belief that it seems almost to have acquired the status of a fundamental first principle of orthodox theory. But a careful examination reveals some grave doubts about its universal validity.

Consider the evolution of a biological structure having an assortment of interacting parts, and to simplify matters assume an extremely simple structure requiring only 12 mutational steps for its evolution. Let the probabilities be represented by a 12-sided dodecahedral die with the sides numbered 1 to 12, *representing the sequence of steps required to produce the new structure during embryonic development.* The probability of the 12 numbers appearing in strict numerical sequence in 12 consecutive throws of the die is 1 in 12^{12}, which evaluates out to 1 in 9,000,000,000,000, an enormous number which confirms the practical impossibility of even this very simple structure evolving in a single step.

I don't think any evolutionist would deny the validity of this numerical analogy. As Richard Dawkins states in his book *The Blind Watchmaker*, "The consequences of mutation on bodies are severely restricted by the processes of embryology... Nothing magically sprouts... Only a minority of things that could conceivably evolve are actually permitted by the status quo of existing developmental processes." And surely nobody would dispute the necessity of strict numerical sequence during embryonic growth. Obviously you can't expect to grow a fingernail in the absence of a finger, or an eyeball in the absence of a bony orbit or socket. To think otherwise is like thinking a brick wall could be built by inserting bricks anywhere in empty spaces in the future wall-to-be.

The question raised is just this: If each of the usable mutations or genetic variations is sandwiched between large numbers of unusable mutations, does this increase the probability of success? It seems quite impossible that this could be the case. *If each of the usable mutations has to occur in some particular sequence, then clearly the interposing of unusable mutations cannot possibly increase the probability of their doing so.* In fact, if many of the unusable mutations are harmful to the organism in which they occur, as in practice they are bound to be, then far from increasing the probability, it must inevitably be reduced. If spontaneous evolution in a single giant step is impossible, then it seems gradual cumulative evolution is still more impossible! This belated but logically dictated finding strikes at the very heart of the Darwinian concept of gradual evolution by tiny intermediate steps spread over immense periods of geological time.

The only counter-argument I have been able to find in the literature is the one that states that any chance event with a low probability can, if it is repeated often enough, have that probability greatly increased. This is perfectly true, and at first sight seems to provide an answer to the whole problem. But it is all a matter of degree, as closer examination will reveal. We started by considering an exceedingly simple biological structure requiring only 12 mutational steps for its evolution, and found that its probability was 12^{-12}, i.e., 9,000,000,000,000 to 1 against. If this whole process was repeated a million times, the probability would increase to 10^{-7}, which is still well into the 'virtually impossible' range (see table).

Consider now a more realistic situation, such as the evolution of a biological organ, such as an eye, or an ear, or a heart. In the absence of an experienced embryologist it is obviously difficult to assess the number of individual mutational steps likely to be required, and all I can do is hazard an intelligent guesstimate. It seems to me that any such organ would require at least 100 mutational steps, and quite possibly 1,000 or more. To be generous to the evolutionists, let us assume the lower figure, 100. This would give a probability of 100^{-100} or 10^{-200}.

Next we have to assess the number of times the whole operation is likely to be repeated. This is still more difficult, but perhaps the 'Cambrian explosion' will provide some clues. This covered a period of 100 million years at the beginning of the Cambrian Period some 600 million years ago. During this 100 million year period, an astonishing variety of complex animal life appeared, with an amazing array of anatomical constructions. In his book *Wonderful Life*, Gould describes these animals as found in an extraordinary fossil bed known as the Burgess Shale, high up in the Rockies. Presumably the vast age of the fossils means that their internal anatomy cannot be studied in detail, but they nearly all had eyes, and presumably also hearts, and digestive systems, also reproductive systems. These organs may have been quite primitive compared to present day standards, but even so, it seems unlikely that any of them could have required less than 100 mutational steps to evolve from the unicellular life which preceeded them. And obviously the total time available must have been something less than 10^8 years. Assuming that a new series of trials started every few *hours*, that would give a maximum possible number of repeat runs of about 10^{11}. Combining this figure with the 'one off' probability of 10^{-200} we get an N_p value of 10^{-189}, which is far below the 'virtually impossible' level in the table. Or to go to extremes in the random-variations syndrome, we could choose an absurdly low figure of say 20 for n, and an absurdly high figure of say 10^{12} for N, giving an N_p value of 10^{-14}, which is still well below the 'virtually impossible' value of 10^{-5}. So much for the 'repeated runs' argument!

It seems that the only possible answer to the quandary raised by this exercise in elementary logic is to admit that, contrary to orthodox teaching, some at least of the mutations or genetic variations used in the processes of evolution, *must* be directed, rather than random or fortuitous. Many evolutionists may find this a distasteful pill to swallow, but there is really no reason why it should be. After all, their beloved theory can continue to work, and things will still evolve through the action of natural selection in adopting favourable variations and rejecting unfavourable ones.

N_p	ρ	Category*
over 10	10^5 to 1	Virtually certain
9	10^4 to 1	Extremely probable
7	10^3 to 1	Highly probable
4.5	10^2 to 1	Very probable
2.25	10 to 1	Probable
0.7	1 to 1	50/50 chance
0.1	1 in 10	Unlikely
0.01	1 in 10^2	Very unlikely
0.001	1 in 10^3	Highly unlikely
0.0001	1 in 10^4	Extremely unlikely
Below 0.0001	1 in 10^5	Virtually impossible

n number of intermediate mutational steps required for the evolution of a biological structure. (Or number of chance intermediate steps in any integrated event.)

p probability of it happening $= n^n$.

N number of repeat trials.

ρ accumulative probability after N trials $= 1 - (1 - p)^N$.

Figure 1: Probability Table

*Note, these categories are purely the author's own assessment, but it is thought most scientists would accept their usefulness as a practical guide.

If Darwin could have been challenged on his assumption that the variations acted upon by natural selection were always random relative to the welfare of the organism concerned, he would, I think, have readily conceded that there was, and could be, no firm evidence in support, and no *a priori* reason making it inevitable.

As regards the question of what is the directing agency, the first thing to be said is that there is nothing in the logic of the situation to justify jumping to the conclusion that 'God' must be involved. All we can reasonably assert is that an intelligence superior to any possible human intelligence is indicated. And who would take it upon himself to declare that the highest intelligence in the vast universe is human intelligence? What is important is not the precise nature of the intelligence involved, so much as the unavoidable fact that it must exist, whatever name we care to give to it. The long-term consequences for the Western world-view are incalculable.

Readers are referred to my book, *Evolution in a New Light,* (Pilgrim Books, Lower Tasburgh, Norwich NR15 1LT, hardback £11 post free) for further discussion.

Review: "The Facts of Life" by Richard Milton

Howard Smith

This book certainly lives up to its subtitle: *Shattering the Myths of Darwinism.* The author—a freelance journalist—undertook his lengthy critical examination of the evidence out of the feeling that the paradigm of Darwinism has become ideological and authoritarian, posing a threat to honest scientific progress and to education.

One by one he examines the pillars of the theory—and brings each one crashing down.

The vast timescales needed for the model of mutation and natural selection require an ancient earth—some 4,600 million years old. A re-appraisal of each of the several methods of dating greatly reduces this age in every case, to somewhere between 9,000 years and 175,000 years. For example, dating based on carbon-14 assumes that the proportion of C_{14} in a sample of carbon has always been the same. Yet there is some evidence that the rate of production of C_{14} is greater than its decay, hence it is not in equilibrium. Allowing for this reduces the age of the earth to less than 30,000 years!

The 'Uniformitarian' theory—that change has happened uniformly—relies on vast timescales. For example, statistical calculations suggest that proteins might spontaneously form from amino acids once in 1,000 million years. Very soon one runs out of time for all the complex processes which must have occurred. Almost more ludicrously, the postulated uniform rate of sedimentation of 0.2mm per year cannot account for burying entire forests or large dinosaurs. The 'catastrophic' model of sudden changes accords more with the facts.

The 'geological column' upon which the sequence of evolution is largely based, is shown to be a synthetic composite based on samples from different regions, leading to wide discrepancies in dating.

The lack of transitional species in the fossil record is a major problem for Darwinists; the 'missing link,' contrary to popular belief, remains missing, as indeed do the links between reptiles and mammals, and primates and other mammals.

Natural selection, far from being 'the survival of the fittest,' usually boils down to effectiveness in breeding. There is no agreed theory as to why some characteristics favour or prejudice survival. Species apparently well-suited to their environment die out after long ages. And surely, if mutation was purely random, one would expect *some* evidence of badly-adapted, short-lived species ('failed monsters')?

The theory of 'vestigial organs' as indicators of our ancestry is shown merely to indicate our ignorance of their purpose. For example, some evidence suggests that the appendix may be a reservoir of antibody-producing cells.

After many chapters carefully weighing a vast quantity of evidence, Milton concludes that "... evidence for mankind's own evolution is non-existent"! He then considers alternative theories, e.g., 'Special Creation,' or a hybrid in which evolution is seen as divinely guided. These too are just theories, he surmises, and they could well be taught in schools alongside the Darwinian model. In each case it is possible to find evidence, and also objections. Milton himself confesses to no religious beliefs.

So how **did** we get here? How does Nature so unerringly reach her goal? Where is the 'controlling program?' Milton speaks of the intrinsic 'wholeness' of an organism, and refers to the concept of morphogenetic fields. He quotes Dreisch, who speaks of "... a unifying non-material mind-like something... an ordering principle."

What exactly is this 'something,' and how does it direct evolution? Milton comes clean: we need more knowledge, he says! But he believes that we are on the brink of new discoveries in the field of quantum mechanics which could explain the origin of life and its mode of evolution. Biology, he says, has been dominated for too long by nineteenth-century mechanistic concepts, and it will only progress when it catches up with modern physics.

The book gives a good overview of current neo-Darwinism and its limitations, although he has little to offer as an alternative. Sadly, in the second edition of the book, Milton complains of the harsh words and vitriolic criticisms he has had to endure for daring to question the accepted wisdom. Such is the price which must be paid by challenging the paradigms of the day.

* * *

Milton, Richard: *The Facts of Life: Shattering the Myths of Darwinism.* Transworld Corgi, London, 1994 edition. ISBN 0-552-14121-6.

Richard Milton is also the author of *Forbidden Science: Exposing the Secrets of Suppressed Research.* Fourth Estate, London, 1995 edition.

Limestone and Schist

Cornelis Bockemühl

Author's preface to the English translation

Among the many fundamental questions to which Rudolf Steiner drew our attention are those of understanding the substances which make up our material 'outer' world. Two of these substances, 'lime' and 'silica', often play a key role in Steiner's lectures on agriculture, on medicine and on many other subjects. The present paper gives an example of a methodologically new approach to understanding these substances, starting from the subject in which we see them most prominently, namely Geology.

What does understanding a substance mean? If I were to tell you that a certain rock contains 2.8% by weight CaO, you would probably not learn a lot about the rock. Nor would it help much if I gave you the figure to one more significant decimal place. However, it would be much more useful if I told you about the CaO-content of many other rocks, at the same time making you as familiar as possible with them. Only in this way would you learn about the role of CaO in rocks and only in this way would the '2.8% by weight' become more and more meaningful. This is all obvious of course, but usually we do not realise what follows from this reasoning: In order to 'understand' a specific substance anywhere in the world, we do not have to measure and study the substance itself in more and more detail, but we do have to study its 'surroundings', possibly even the rest of the world as a whole!

This is illustrated from another point of view by the serious problem for science of dealing with difficulties raised by pollution. For today's scientists it is much easier to provide more and better measurements of all kinds of polluting substances in air, water, and soil etc., than saying what precisely these measurements mean for the earth and its biosphere! We know many single words, but we have only a nebulous knowledge of the language...

The main methodological aim of the present paper arises from these problems. It seems to me necessary to overcome the somewhat simple 'phenomenology' of much of the work done so far on 'lime' and 'silica'. Looking at limestone, silica-bearing rocks and minerals can only be a beginning. It cannot be something that only has to be summarised and to a certain extent reasoned about, in order to be a useful 'result'. The fundamental meaning of the terms 'lime' and 'silica', as Steiner used them, cannot be clarified just by examining the substances themselves, but should be used as a 'standpoint' from which to look into the whole world, including the human world. In what follows I give several examples of what is meant by this idea. I shall describe landscapes dominated by either the one or the other rock type and discuss the different ways of thinking developed by various geologists who have studied the geology of these landscapes.

The lecture by Steiner on 2nd July 1922 (see References), which specifically inspired the title of this paper and the choice of areas for study, does not start by referring to 'lime' and 'silica'. Instead, Steiner spoke about the geological *'Kalkformation'* (limestone formation) and the *'Schieferformation'* (schist formation) — both very broad and unspecific terms — and only later went on to refer to 'lime' and 'silica'.

This paper is a concise account of project work done within the framework of the one year course in natural science (1988/89) at the Natural Science Section of the Goetheanum, Dornach, Switzerland. (Translated by David J. Heaf from *Elemente der Naturwissenschaft* 51, 2/1989, pp 50–80 and printed here with permission from the publishers of the original.)

1 Summary

This paper deals with the relationship between limestone and schist by comparing first of all landscapes, then individual pieces of rock. It is shown that, by examining the same things in each case, different thought processes characteristic for the rocks are set in motion; these processes are considered. Finally, ways of thinking developed for geological research into the landscapes in question are also examined.

This work is particularly concerned with establishing, step by step, the levels of experiencing reality which are accessible to the actively perceiving and thinking human being.

2 Formulation of the problem and an introduction to the geology of the Basel region

A scientific investigation needs not only an idea as a point of departure, but also above all a concrete object with which it can actively become involved. As a concrete object for this geological study there were just two areas of choice where the rocks of interest, limestone and schist, are found in one form or other. Figure 2–1 gives a general overview of the Basel region.

The oldest rocks are summed-up as 'black forest crystalline'. They extend under all others and, on the map, only appear again in the Vosges. They are chiefly granite and crystalline gneiss formed mainly by metamorphosis of sediments, partly Variscan (*Hercynian*, Tr.), partly older still. The geological history is complex and in many respects, for instance the exact age classification of the various metamorphic events, is still open to question. Over this basement lies, with gaps, firstly a small amount of *Rotliegendes* (red beds of the European Lower Permian), and over that the Triassic sediments — in the 'Germanic' formation as Bunter sandstone, *Muschelkalk* (shelly limestone) and Keuper Marl (Red

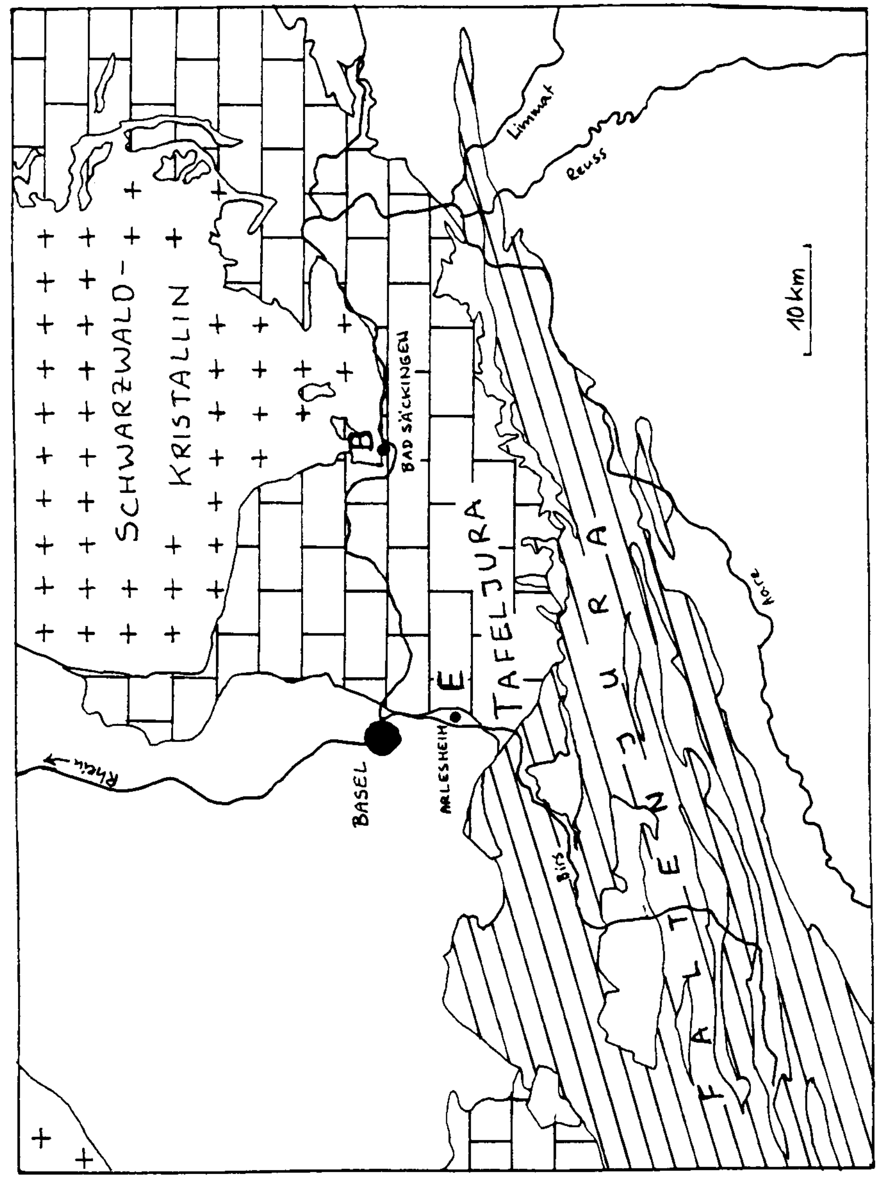

Figure 2–1: Most important elements of Basel regional geology. The Table Jura *(Tafeljura)* becomes the Dinkelberg to the north and the Swabian Alb to the north east. (See text for detailed explanation.)

Marl) — followed by the Jurassic Lias (Lower), Dogger (Middle) and Malm (Upper). The last two, with their clays and limestones, are especially predominant in the Jura mountains. There is no Cretaceous in the region. Finally, in the Tertiary period the landscape was formed into the large features which are present today. Thus, in the Oligocene the whole area of the Black forest and Vosges rose like a dome, so that the old crystalline core, again exposed, was eroded and at the same time the Rhine rift valley broke through the middle of this dome. The many faults in the Table Jura and those with a NNE–SSW strike in the faulted Jura are side effects of this rift. Then in the Miocene the faulted Jura formed as a conclusion so to speak of alpine faulting and as a long range effect of the same. The area left white on the map (Figure 2–1) in the regions of the Rhine rift valley and Swiss midlands are filled today by tertiary and quaternary deposits (the latter as fluvioglacial terrace gravel). The immediate area round Basel was not covered in ice in the ice ages, only part of the upper Black Forest, the Jura and the Midlands.

Within this region, two localities were chosen for study. The choice was made mainly for practical reasons. The first is 'Ermitage valley', lying east of Arlesheim village (see also Figure 2–2) and designated with the letter 'E' on the map. The second is what I called 'Bergsee area' after the artificial lake it contains (see Figure 2–3) and is designated with the letter 'B' on the map. To layman and geologist alike, the term 'schist' would bring to mind something like phyllite or mica schist rather than the gneiss of the southern Black Forest. But once one takes 'being schistose' as the essential feature, it seems to me not inappropriate to consider gneiss as an example of the 'schist formation' of interest in this study.[1]

3 Rocks and Landscape

3.1 A first encounter with the landscape

Arlesheim is the most accessible starting point for a tour of the Ermitage area. The heart of the village spreads out over an area of the east bank of the river Birs, separated from the latter by an initial gentle rise. Where the buildings allow a view between them, to the west and north the horizon appears completely bare, and to the south one can make out at some distance the Blauen mountain chain. To the east however, the village is immediately bounded by a steeply rising hillside covered with deciduous trees, so that one can sense immediately that this is the back of the village. There too, jutting out and dominating the village, the ruins of the two castles, Birseck and Reichenstein, catch the eye.

[1]The German word *'Schiefer'*, is much less specific than the corresponding English 'schist' The former includes slates, which can be considered sedimentary or only slightly metamorphosed, as well as schists, which are crystalline and more highly metamorphosed as are gneisses. In the same lecture Steiner spoke of the aforementioned rocks as 'formations', thus drawing our attention to the processes as distinct from the inherent substances, lime or silica. In this context, 'schist' is the most appropriate translation, because the essential feature of the *'Schieferformation'* is its schistosity, which also embraces gneisses.

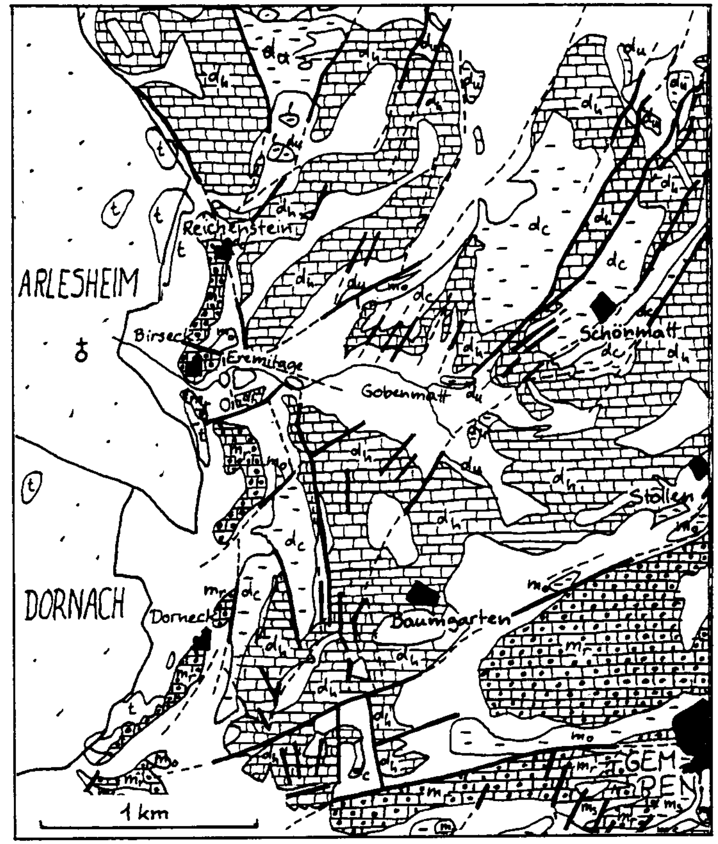

Figure 2–2: The surroundings of Ermitagetal. t_r = *Rhät* (Keuper), l = Lias, d_u = Lower Dogger, d_h = *Hauptrogenstein* (middle Dogger), m_o = Oxford Marl (lower Malm), m_r = Rauracian coral limestone (middle Malm), m_s = Séquanian (upper Malm), t = Tertiary. Thick lines = tectonic disturbances (Table Jura faults).

Leaving Arlesheim in an easterly direction we immediately reach the first ruin. The village stream, ducted underground within the settlement can be seen after the last building. A few hundred metres beyond this, right at the southern foot of the hill crowned by Birseck castle, we come to a small group of buildings including a disused watermill. Here, on either side of the road and stream, the land rises steeply. Several bizarre limestone formations are revealed amongst the trees. Proceeding only a few metres further, the valley somewhat opens up again, with a small meadow occupying the valley floor and we are as if in another world, the Ermitage, which was not visible prior to entry, because the narrowness acted like an entrance door. In contrast to the Birs valley at Arlesheim, the distinguishing feature of the form of this landscape taken as a whole is its compactness. It can be experienced differently in different places; here more as a feeling of security, there more as confinement or seclusion.

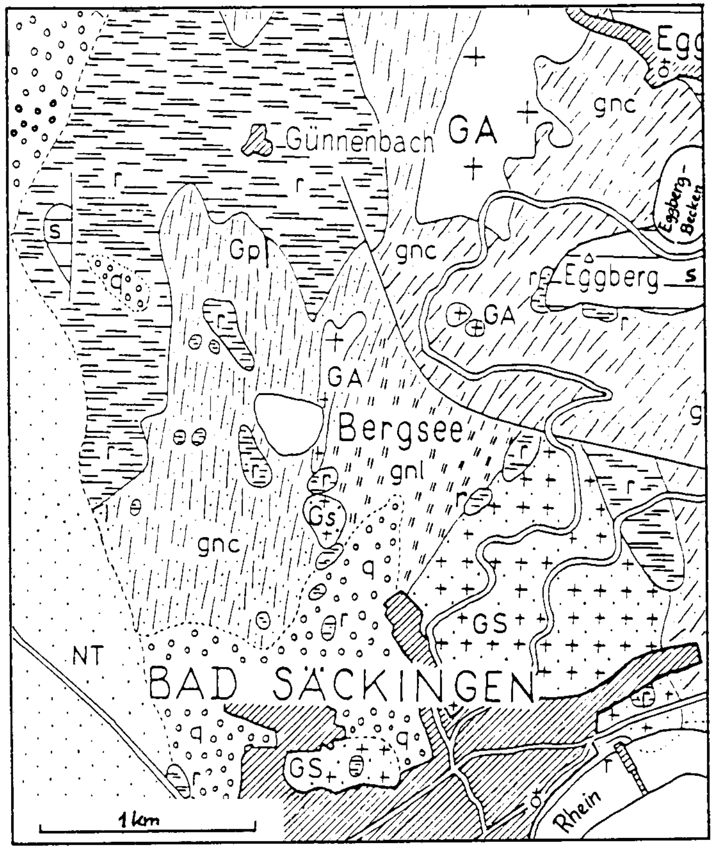

Figure 2-3: The Bergsee area and its surroundings. **gnc** = Cordierite gneiss, **gnl** = Laufenberg gneiss, **GA** = Albtal Granite, **GS** = Säckingen Granite, **r** = *Rotliegendes* (Permian), **s** = Bunter sandstone (Triassic), **NT** = lower terrace rubble, **q** = unstructured Quaternary.

An important part of the lower Ermitage valley is the sequence of three small ponds formed by damming the stream. Of these the middle one, with its ducks, is the most accessible and attractive to people out for a walk. The margins are thick with reeds and the lowest of the three is almost completely overgrown. Between the middle and uppermost ponds is a farm with another disused water mill, seemingly jammed into a wooded gorge. The ponds hardly catch the eye however. Not every walker passing here for the first time notices all three of them, although they almost certainly walk beside them!

In the middle section of the valley, in the region of the uppermost pond and a little beyond, the climb gets steeper in several small stages as far as Gobenmatt (Figure 2-2). Places can be found in this section of the valley which are somewhat more open and to a certain extent allow an outlook over the valley as a whole, especially where the woods

Figure 4-1: Cliff face between Birseck and Reichenstein castles (16 January 1988).

otherwise dominating the slopes, are penetrated by a few steep meadows. From here on, the barrier which separates the Ermitage valley from Arlesheim appears no longer as a wooded hillside, but as gleaming white cliffs. Further up the valley more rock faces can now be seen, mostly in the middle or upper part of otherwise very steep slopes. In addition however, the slopes do not simply run uninterrupted along both sides of the valley. It is precisely their advance, retreat and being cut into by small side valleys which is a prime reason for the aforementioned dividing up of the whole valley.

However Gobenmatt, the highest section, is less steeply sloping than the middle section and here again the hills on both sides come closer to each other. Thus Gobenmatt itself appears as a meadow occupying the lowest northern slope of an elongated hollow, in the woods at the head of which is situated the source of the stream which flows along the floor of the Ermitage valley. Here can be found various springs as well as open, markedly damp places.

Finally, the head of the valley is a star-shaped arrangement of little, steep, wooded, V-shaped valleys, which all run roughly towards upper Gobenmatt. Taking one of these running almost directly up the valley (to the right of Hornichopf), it becomes increasingly narrower towards the top and where it peters out as only a metre deep groove in the ground and the woods come to an end, we find ourselves quite unexpectedly in the gentle orchards and fields of the small hamlet of Stollenhäuser. Once again it is a very abrupt transition, like the entry to the valley below, but with a different character.

Stollen is situated together with the Schönmatt farms to the north west and Baumgarten to the south west of a clearly formed terrace in open country. Here then are orchards which throughout are not particularly steep, as well as pasture and arable fields and of course, one is raised above the bustle of the Birs valley. Nevertheless, because of the next rise in the ground to the east, the place seems sheltered somehow, and here too there is, so to speak, a front and a back. The final stage designated leads ultimately up to the Gempen plateau and the villages of Gempen and Hochwald.

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I would like to present, also by means of a tour on foot, a brief characterisation of the second landscape which I called the 'Bergsee area' in section 2. I would like to take as the starting point for this tour the Brennet railway station in the Rhine valley, about 4 km north west of Bad Säckingen. Here, the plain of the Rhine valley is in fact nowhere near as broad as in the Rhine rift valley north of Basel, but broader than at Bad Säckingen. At first glance, it gives the impression as far as land usage goes of being somewhat chaotic. There are a few settlements, mostly originating from the last decade, none of them, however, giving the impression of a growing village. Near these are also areas of land for agriculture, which though in parts is worked very intensively, gives more the impression of farmland soon becoming disused than of a rural district with cultivation. A few commercial and industrial concerns are scattered quite haphazardly.

Moving a few streets away from the station in a roughly easterly direction and passing under the disused railway line to Wehr, we come up above a rise in the land of a few metres

Figure 4–2: Gneiss rocks west of Bergsee (24 November 1987).

onto a small plateau which, apart from a sports ground, already gives the impression of being more rural. Following the road from the sports ground leading due east to the mountain slope, we can experience a sharp transition, just like the entrance to the Ermitage valley. Quite suddenly, we find ourselves in a wood with a view to the left over the small shallow valley of the Rötel stream splashing through an area of what is at present, flourishing open meadowland. However, the transition here is not provided by a marked formative element in the countryside, but simply by the fact that the land now begins to rise more steeply.

After a short time in the woods — mostly conifer — Günnenbach is reached. This is a clearing on the slope with a few isolated farms. In comparison with the Rhine valley

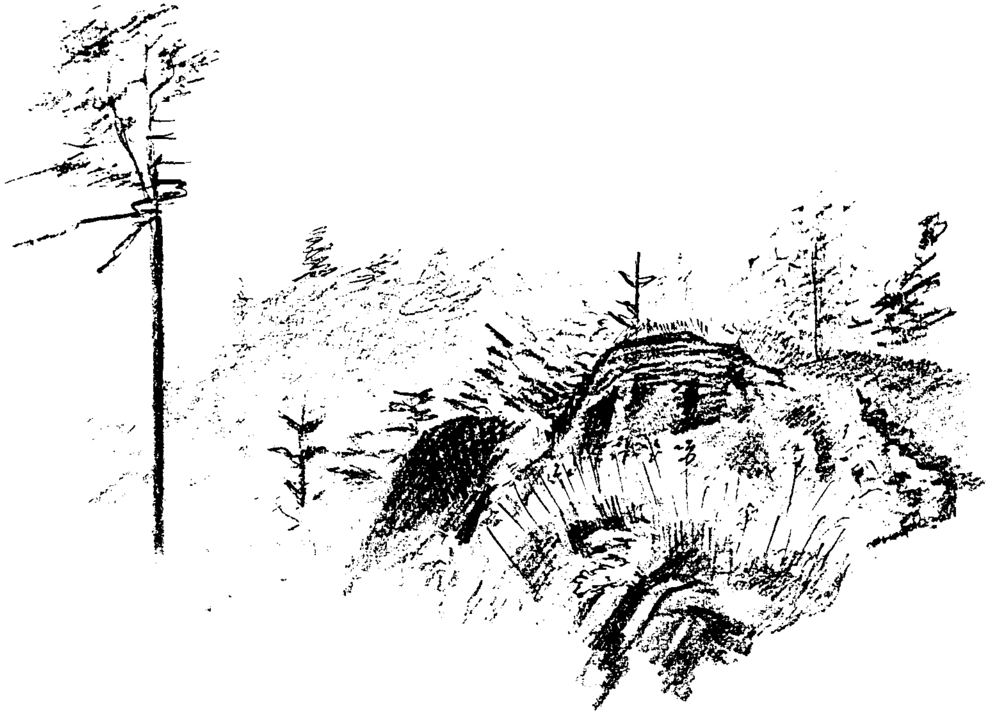

Figure 4–3: Immediately above Bergsee: massive gneiss on the right (19 October 1987).

described at the beginning, one definitely gets the feeling here of an 'unspoilt idyllic rural situation', at least as a first impression. In comparison with Stollenhäuser, the countryside is very sloping and on the whole not much leveller than the surrounding woods. Thus, because the clearing does not form a distinct step in the terrain, it also does not appear to be a world particularly cut off or standing out. The view westwards, where the Rhine valley to the left and Dinkel mountain to the right provide the backdrop, is open and clear.

We now leave the clearing on the track to the lake (Bergsee). Here, in comparison with the Ermitage valley, it is very noticeable all around that water is encountered much more frequently, be it in the form of small drainage ditches — at Günnenbach or beside the road — or as puddles or damp places elsewhere in the area. Moreover, before the lake comes into view as we approach Bergsee, an aqueduct typical of the Hotzenwald region, a so-called 'Wuhr' can be seen. It is a small channel in the woods which would appear to supply Bergsee, an artificial lake, with water. On reaching this Wuhr we find ourselves facing a small ridge or embankment under which the Wuhr is led through a culvert. We can climb the embankment and from here, by turning slightly to the left to Scheffel Rocks, reach the most prominent viewpoint. Up there we are amongst numerous metre

Figure 4–4: Birseck castle viewed from the Ermitage marl-pit (16 April 1988).

sized granite boulders and can now view Bergsee from above.

The lake is set in a hollow of wooded country. In contrast to the ponds of the Ermitage, which anyway are much smaller, it is totally free of reeds or other vegetation. Because of this, land and water appear very distinct. No transition zone separates them. The earth dam which bounds the lake in the west is hardly noticeable, however.

In comparison with the Ermitage valley, one characteristic of the landscape round here makes its description more difficult. No obvious route presents itself, as it does in the Ermitage, where we could simply follow the valley. Instead, with a certain arbitrariness, one has to pick out one's own route. On the whole, the land climbs steadily from the Rhine valley, first to Günnenbach and Bergsee, which are about half way up, then to the high plateau, where more small farming villages are situated, such as Egg and Jungholz. Considered in more detail, this ascent is broken up either by a large number of small hills scattered seemingly arbitrarily, as for instance the one with Scheffel Rocks, or by hollows like the one occupied by Bergsee. Here too of course, the little valleys are, so to speak, the seemingly logical formative element. However, there is such a large number of them they can hardly be described as an ordering principle. Only a few of them stand out, looking almost gorge-like. An example close at hand is the valley of the Schöpfle stream which flows almost easterly from Bergsee down to Bad Säckingen and supplies the Wuhr with its water. A few kilometres further east is the much larger and better known Murg valley, with its precipitous cliffs, a contrast to the rather pleasant, gentle landscape here.

3.2 The appearance of the rock itself

By taking any route through the Ermitage valley, after a few paces, except perhaps in the meadows, one would be sure to come across pieces of rock lying on the ground. They gleam one against the other, yellowish, reddish-brown or white. When a few of them are collected together from different localities, corresponding characteristic differences can be observed. The commonest, *Hauptrogenstein* (Dogger, Middle Jurassic), made up of millimetre-sized little spheres (ooïds, from which the rock's name 'oolite' is derived) is distinguishable at first glance from the plain, massive and lighter *Rauracien-Korallenkalk* (Malm, Coral limestone, middle Oxfordian) and the obviously darker grey or red brown limestone of the Lower Dogger which can be found round Gobenmatt. If we are not content with only picking up odd pieces lying around, we must be on the look out for rock exposures. These are easy to find however. In winter especially, when the woods are not covering everything, one can see larger natural outcrops jutting out all round the area. To get to them, one often has to clamber up quite steep slopes, only to come up against a cliff face stretching both left and right, a *'Fluh'*, as is to be found all over the Jura region.

In sharp contrast to the ease of finding and distinguishing the various limestones of the Ermitage valley, it is impossible to gain a complete picture of the rocks, because some, which are by no means the lesser in quantity, are still missing. These are the clay and

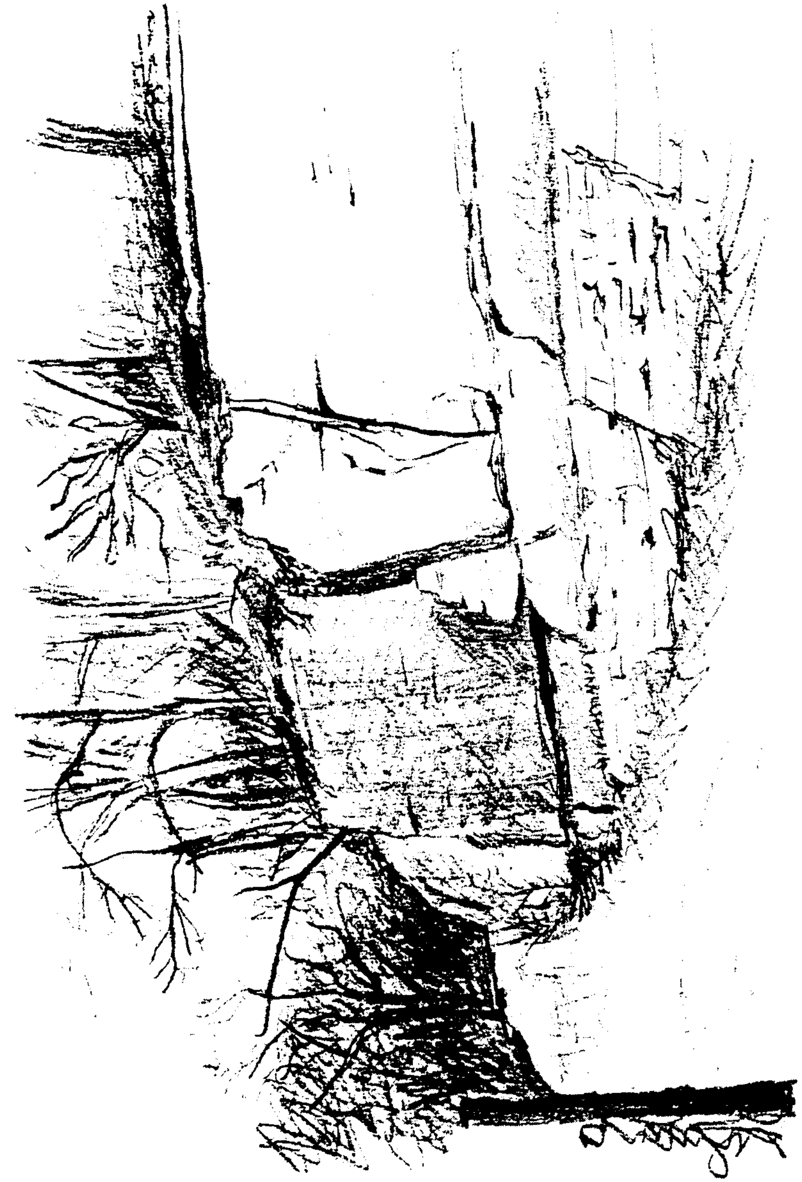

Figure 4–5: Hauptrogenstein, just below Schönmatt (upper Ermitagetal) (9 March 1988).

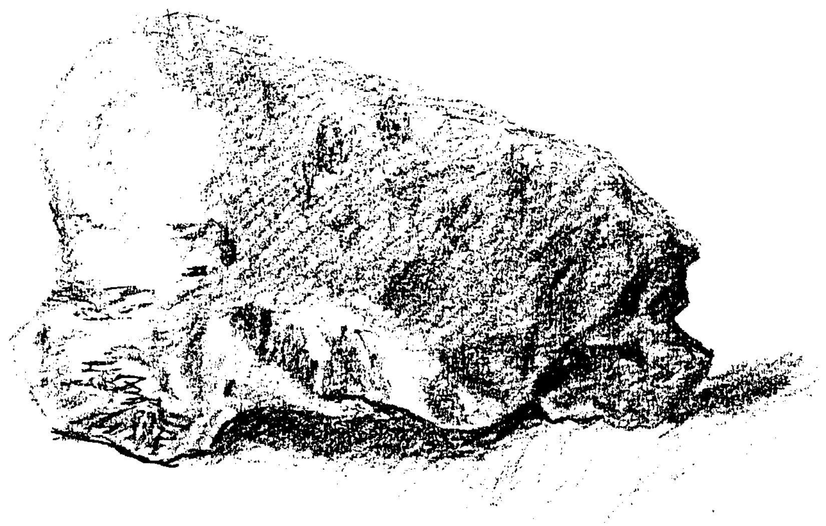

Figure 4-6: Malm coral limestone from the Ermitage (Track north of Birseck castle).

marl strata which are invisible and inaccessible buried under meadows! There are only indirect observations for these strata, such as somewhat concave curved landforms, which allow a certain amount to be concluded.

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If instead we now enter the Bergsee area, we must change our ideas. It is no longer so simple to find bits of rock, but it is not difficult to establish differences. Quite the contrary: apart from variations in shape there is now a greater variety of colours including grey, brown, reddish, white, green and black etc. But this variety would hardly impress the geologist at first, because it completely covers up what in fact he wants to see: Have I a granite or a gneiss in my hand? What minerals does this rock contain? etc. Here we are confronted by a phenomenon which in this form is practically absent from the Ermitage, namely weathering. And either some hammer work is called for in order to penetrate deep into the rock, thus enabling the original minerals to be properly differentiated, or one needs some detailed experience of the landscape concerned in order somehow to see through the variety of weathering effects to the rock itself. With the latter however, a significant difference between the two areas is revealed, not so much in the fact of weathering, but in the way it manifests itself. Of course, all the typical limestone forms of the Ermitage, for instance the cave by the Birseck ruins, exist because of weathering. The fact too that fossils can be so easily seen in the bits of rock lying about there, is the result of weathering. But all this refers to the external form only. In the same sense in which in the Bergsee area one can find weathered rock, such as altered granite and gneiss, one will only very rarely encounter weathered limestone!

It is also possible to find rocky prominences in the Bergsee area. There it is a case of rocky mounds at most 10–20 metres high in the woods or by road cuttings. Apart from

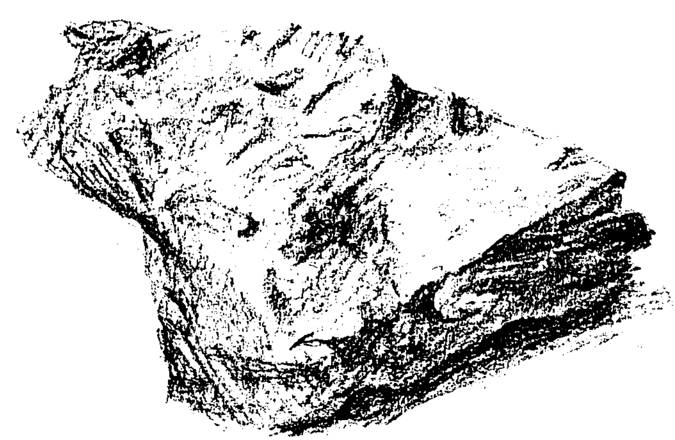

Figure 4-7: Gneiss from the Bergsee area.

the isolated granite cliffs already mentioned they rarely jut out of the woods and are on the whole easily accessible.

3.3 The influence on settlement and land use of the landscape forms determined by the rocks

In both landscapes under consideration rock types occur which on the one hand are durable, which stand out, form cliffs and taller mountains, and the other hand, those in between, which are subject to weathering, which adapt their form and create connections. This contrast is especially noticeable in Jura. Several mountains have a skeleton of limestone whereas, amongst these, the clays form flatter areas and hollows as if suspended in between. The fact that the land forms as a whole are not precipitous and rugged, but gentle and even, is often attributable in the Jura to the afforestation. In the Bergsee area the Alb valley granite is the cliff former whereas the Gneiss adapts itself more easily, but the contrast there is nowhere near as marked. Thus, gneiss also forms mountains, only rounder and not so precipitous. Gneiss forms cliffs too, which can often be found in the woods. However, the prominent rocks jutting out of the woods (Scheffel, Jungholzer and Sol rocks) are of granite.

We can now go into more detail by establishing the direct relationship between land form and the underlying rock. Thus, for instance, there is a connection between the appearance of natural terraces usable for agriculture, which are of course somewhat typical for Jura, and the alternation of clays and limestones which is not haphazard. The layers alternate about every 100 metres, sometimes lying horizontally, sometimes tilted or vertical and occasionally displaced on subvertical faults. Now at this stage one runs into obstacles. This is not because for instance the factors to be taken into consideration become overwhelming or one no longer understands what one sees. Rather

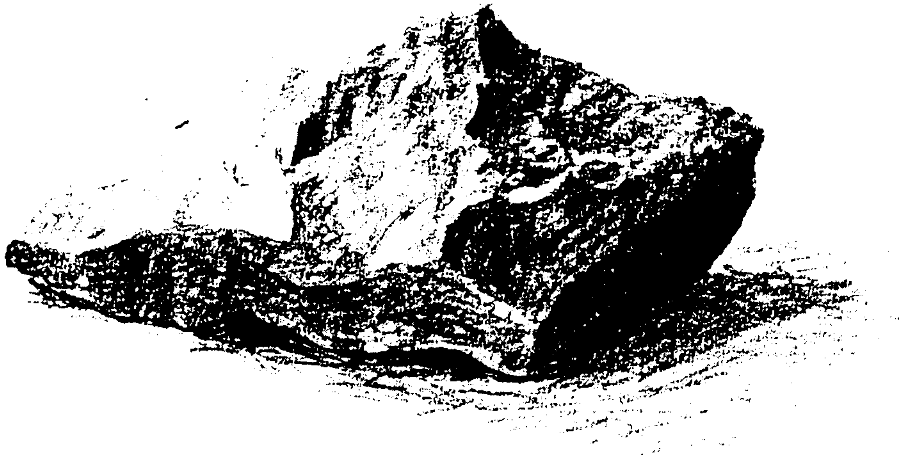

Figure 4–8: Hauptrogenstein, track approximately north east of Birseck castle.

is it that the object of investigation escapes one in quite another direction. Thus, even with the example just given, the objection can of course be raised that there are natural terraces used for agriculture in the Bergsee area, such as Harpolingen and Rippolingen villages, which have nothing to do with clay or limestone. To that one might argue, somewhat weakly, that they appear quite different from for instance the terrace of Stollen hamlet! Here, therefore, it is clear that the objection mentioned would only be possible because by reducing the land form experienced as typical for the Jura to the single concept 'terrace', things absolutely essential to it are lost, namely the way the land is built up and what makes it so unforgettably Jura-like! At this boundary of knowledge an important question therefore seems to arise: Does the concept used (e.g. 'terrace') embrace what is really meant (in this example 'the Jura-like')? More precisely, is the concept really sharp enough?

Just as there is no doubt that the task facing the scientist lies in coming to clear concepts ('explanations') expressible in words, so too it is clear that with the question at issue here, it must be a case primarily of developing a certain feeling for character. We all have this faculty and it alone enables us straight away to distinguish things such as a Jura-terrace and a Hotzenwald-terrace from one another.

4 The form of the rocks

4.1 Sketching rocks in the landscape

Here I have limited myself to the technique of black and white sketching with a soft lead pencil in the hope with this method of being able to capture most easily something of the characteristics of the forms. Also, I had the particular object of study in front of me.

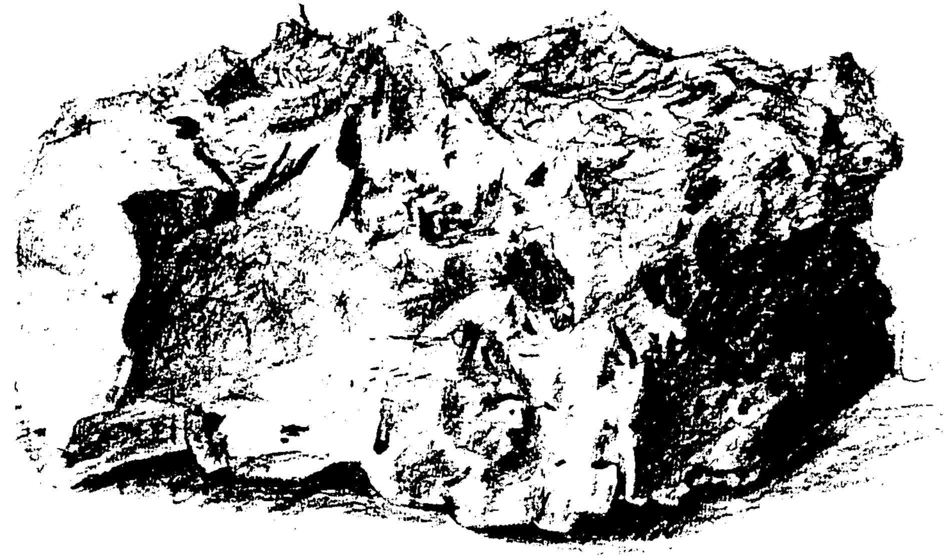

Figure 4–9: Malm limestone from the Ermitage.

This means that for each picture there is a definite standpoint from which it presents itself as it is drawn.

Figure 4–1 shows one of the many cliffs mentioned in section 3.2 which gleam out especially in winter. The point from which it was sketched is on the northerly approach road to Birseck castle. I have made quite intentional use of a technique which from my previous experience I have found to contribute a lot to the impression of a Malm limestone. It involves directing one's whole attention first of all to the surroundings and not to the rock which is to be depicted. This is left as a white space and is first encountered in outline whose left side, for instance, is very sharp whereas along the lower edge it is more a case of creating a transition between dense woods and those where the rocks are beginning to shine through a little. Finally, the details of the rock itself must be worked on — lighter and darker streaks, shadows and fissures — but this must be done with as little expenditure of effort as possible to avoid losing the clarity of form and the gleaming character. To my mind, the latter exists by no means only through the fact that the Malm limestone is almost white, but at least as much through the appearance of the transition to the surroundings.

This may perhaps be clearer by comparison with Figure 4–2, a gneiss rock face due north above Bergsee. The technique of keeping free at first and of paying special attention to the transition to the surroundings was used to some extent here too. Quite simply, this is necessary for the rocks as such to show up at all. But in order to catch something of what constitutes the gneiss-like character in the picture as well, far more attention must

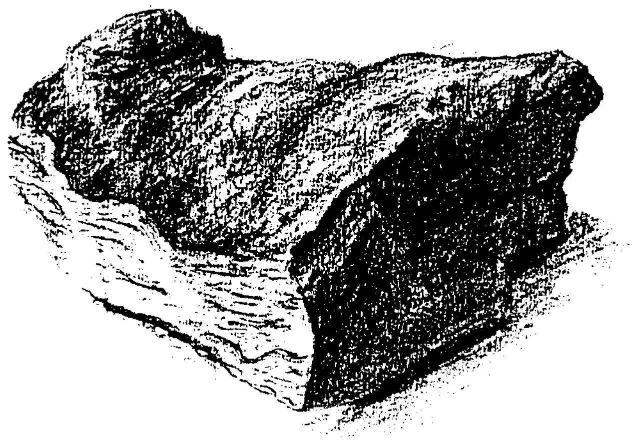

Figure 4–10: Gneiss from the 'Silver Hollow'.

be devoted to bringing out details of the rock form. Perhaps this is still more successful in Figure 4–3. On the other hand, Figure 4–4 shows an example, again of the Ermitage, of where bringing out the form of the rock itself was almost completely dispensed with.

In the Bergsee area it was very difficult to find rocks which could properly be portrayed by sketching. Even when one was found, a convenient standpoint for observation was not available. In the Ermitage, it was sketching Hauptrogenstein (Dogger) which gave me a lot of trouble. This, in contrast to Malm/Coral limestone (Figure 4–1), shows a pronounced, roughly decimeter, layered structure. Here too, it emerged that in order to retain the limestone character, one must not fiddle about too much with working it out to the last detail. This, however, is very difficult to resist, because as a precise result of the layering, so many of these details leap out at one straight away. The most successful portrayal of Hauptrogenstein is Figure 4–5.

4.2 Sketching individual pieces of rock

Whilst also attempting to set down a few experiences which can be obtained from sketching individual pieces of rock placed on a table, it is inevitable that much said in section 4.1 seems to be contradicted. However, this is not in fact the case, because what is being put forward here is aimed at nothing more than describing the method. This should help the reader initially to co-experience something of the feeling for character mentioned in section 3.3, as well as showing those who wish to set about observing and drawing rocks themselves a few points which might be worthy of attention. However, it is expressly not intended to be a final self-sufficient conceptual result of my efforts so far, which have been as phenomenological as possible. Because, if this were the case, the actual advantage of this way of working, namely the real living experience, would simply be lost.

A typical piece of Malm limestone is shown in Figure 4–6. The form does not appear fragmentary or angular even though a few prominent edges divide the stone up into

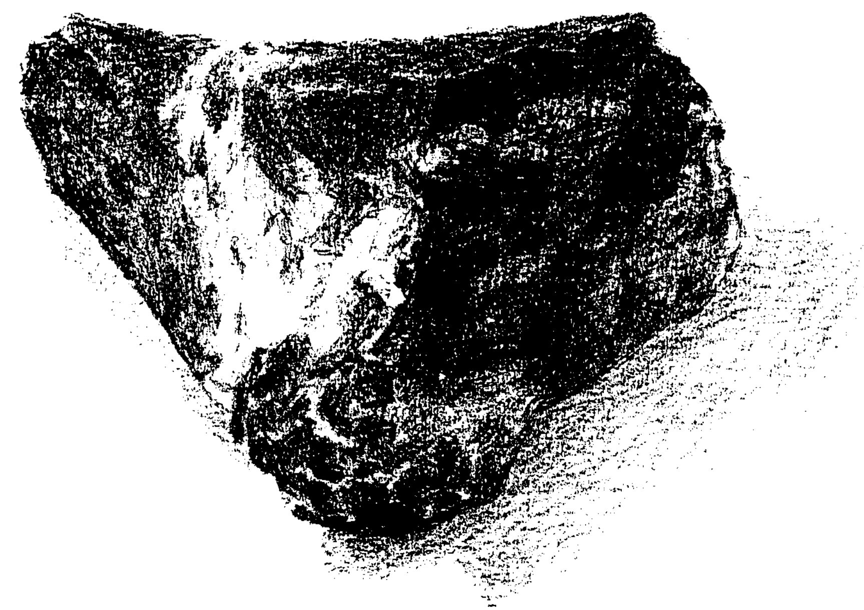

Figure 4–11: Migmatite from the Wickartsmühle quarry (near Willaringen).

several parts. Thus, the upper side, sloping down to the right, is quite smooth and domed only slightly. Because of this, only a few slight dents are noticeable. Something is visible on the right and below, which continues round to the part of the stone hidden from view: a surface split up by deep fissures, all in miniature, with deep holes and sharp, but not broken, edges. The left side shows the same but much less pronounced. The recent history of the stone is very clearly reflected in these various outer surfaces. Whereas the underside was stuck in the ground, the upper side was in the open. With that orientation the stone was situated on the edge of a path and worn smooth by passing feet.

On the other hand, with the gneiss shown in Figure 4–7, the form of the stone is completely determined by how it was broken. It is obviously divided into individual fracture surfaces which are separated from one another by sharp edges. But in addition, these surfaces are formed differently. The top seems almost haphazardly dotted with small corrugations and lumps. On the front, however, it became especially clear during sketching that here, far more than with the limestone described above, it matters that the light and dark components of the outside are depicted as well as the light and shade which are determined by the lighting conditions and which make the form visible. It was found that this can best be achieved by devoting all one's attention either to the one or to the other at any one time. That the stone becomes a whole at all and appears self-contained is brought about by working on the relationships of light and shadow. However, the lightness and darkness of the outside gives rise to a very special character, but if it is overdone, the whole picture disintegrates.

Figure 4–12: Fossils in Lower Dogger from Gobenmatt.

What has just been said proves to be typical for gneiss as does the presence of the layered structure which shows up to some extent on the front of the piece shown in Figure 4–7. This is clear from comparison with Figure 4–8. This shows a piece of Hauptrogenstein which likewise exhibits a planar structure. At first glance, one could certainly exchange the illustration for the one of gneiss. But when working on it the need becomes apparent to avoid precisely that alternating attention described above and to try always to bear in mind both aspects. However, in contrast to what was stated in section 4.1, it proves to be nowhere near as counterproductive to give a lot of attention to the elaboration of form, as shown in Figure 4–9 for example.

4.3 Some elements of form in detail

So far an attempt has been made to pay attention only superficially to all available details of form as such, without other distinguishing criteria such as the question: What do they contribute to the way the object appears as a whole? But even on the scale of individual hand samples, one does not get as far as concerning oneself with such things, which in a certain sense also deserve attention purely in their own right. Indeed, without using this sketching procedure it would by no means be so easy to deny these details of form one's attention for so long! It must certainly be in this connection that what is meant here by the elements of form, in complete contrast to those shown in the previous chapter, also all have individual names: layering, cleft, stratification, foliation, fossil, mineral grain and many others. Of course these are all very different from one another, but, as mentioned above, they have one thing in common: They are each capable of being expressed in words and in each case their significance is revealed quite independently from all else appearing on the rock sample in question. A few examples should make this clear.

Figure 4–10 shows a gneiss on which one can clearly make out a foliation parallel to the

top surface. It is distinguishable by horizontal striations on both the visible narrow sides but not on the top. But one does not yet see what really makes a foliation something special. Perhaps it is clearer with Figure 4–11. According to the terminology of the present literature of the region (see section 6.1), here we see a gneiss anatexite, or more commonly expressed, a migmatite, which consists of a paleosome and a leucosome. In the example here, the paleosome comprises the dark part of the stone which in addition shows a foliation (the dark spotted mineral grains, several centimetres in size right at the bottom, would be considered as something else: a pinitised cordierite (?)). The leucosome comprises the light, unfoliated and granitic component. Yet in addition, the two concepts paleosome and leucosome include the fact that the latter somehow appears younger. That goes for all cases, even if conscientious authors, in my view rightly, take a lot of trouble to keep ideas of origin associated with these terms as unconcrete as possible. How can one appear younger than the other? Quite obviously it has something to do with the fact that the leucosome cuts through the foliation of the paleosome. But for this penetration to have such a meaning is connected in turn with the fact that the concept 'foliation' actually embraces more than simply 'planar structure of the rock'. This assertion can be denied and the term simply redefined: My foliation concept should not include what is not visible right in front of me. However, as I see it, we have here not only a problem of haphazard definition but also, as can be seen by anyone, the above assertion is far more justifiable from the way the concept is commonly used. This will be discussed in section 5 and beyond.

At this point, however, I should like to take another look at Figure 4–12, a limestone from the lower Dogger. Here too we are confronted by elements of form meaningful on their own account in the sense explained at the beginning of the section, namely fossils, in particular two large mussel shells. That here the concept 'fossil' also signifies more than the description of an external form, though somewhat differently from 'foliation', can hardly meet with contradiction. This is because so far it is generally used purely intuitively and not on the basis of some explicit definition such as: A fossil is just the remains of a former living organism. And one seems to be able to see this, even though, of course, very many of the animal and plant remains discovered have never been caught alive by anyone. More will be added in this connection in section 5 and in what follows.

These are in themselves only a few examples chosen from many. How can one grasp what is special about them still more clearly? So far in this discussion, an attempt has been made to proceed in a way which takes into consideration only the sense perceptible. Even so, it does not appear to have resulted in some concepts 'formed directly on the object', but in two different things:

- Firstly, in a personal inner enrichment which manifests itself in a more refined feeling for a certain region of experience, in this case the forms of rocks and landscapes, as well as perhaps not a satisfied, but a heightened interest for what is observed. This approach can be deepened as much as one wants, but will not be developed further here.

- Secondly, in what emerges from things which previously one had completely accepted as 'given purely by the senses', as shown by the examples above. However, this is at first a negative definition, and with a foliation-in-gneiss or a fossil-in-limestone — to pick out something characteristic for both kinds of rocks — one can now do not more, but substantially less than before. Therefore at this boundary it is necessary to transform into something new the approach used so far, which was only directed to the outer phenomena. By doing this we leave the realm of the first form of experience of reality in order to progress to a second.

5 Foliation and fossil

5.1 Contemplation of tiled floors

After spending some time on the problem discussed in the preceding paragraphs, the idea of how it could be clarified came to me at the sight of a tiled floor. There appeared to be four possibilities as illustrated by the four parts of Figure 5–1.

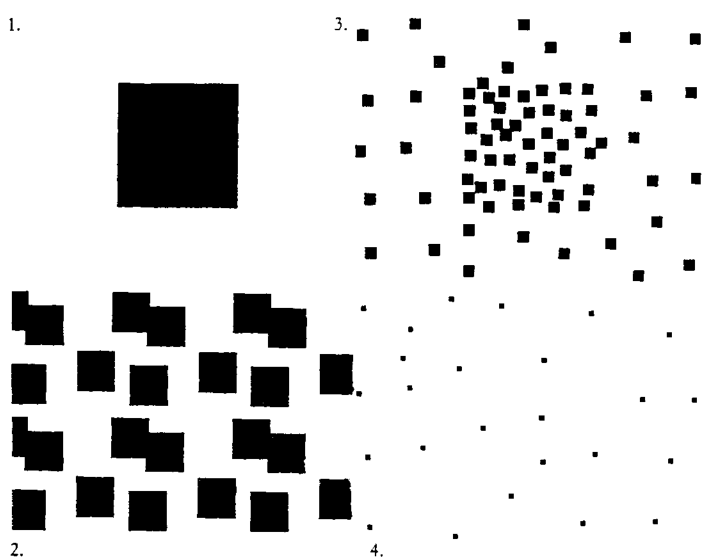

Figure 5–1: Squares: parts 1 to 4.

Figure 5–1.1 shows a single tile. By glancing at it, the concept 'square' can emerge for us. But how does this stand in relation to the phenomenon? Quite simply because it is a question of a square tile. The squareness resides directly in its nature.

Figure 5–1.2: Here the conditions are different. We see a lot of tiles in a very particular arrangement. Looking at it, we notice that in it some pattern is at work, in that the parts are repeated in a regular way. One could cut out a square of a very definite size, duplicate it, and by placing the new tiles close to each other, repeat the original pattern for as long as one wants. But in this case, the pattern does not reside in the nature of the individual tile. As long as none are missing and their interrelations are not disturbed, they could just as easily be round or hexagonal.

Figure 5–1.3: Here again we are confronted by a square, only of a different sort. It is also by no means dependent on the form of the single tiles, nor does it matter if a few of them are missing. We might even be tempted to maintain that the square is not visible at all, but exists solely through our complementing imagination — strange though that we cannot quite so easily make it into a triangle with our imagination!

Figure 5–1.4: After first being faced with this picture, no further difficulty arises. Here we can imagine all or nothing — the arrangement of the tiles leaves us quite free. If we are not splitting hairs, wanting to interpret disorder as a kind of order, then there is nothing to be found in this phenomenon.

5.2 The idea in its form expressible in words

Although the principle observed can be shown clearly by the example of the floor tiles, it is nevertheless not really clear in this form. And if no attempt is made to raise it to a higher level, then one will soon find oneself becoming lost in the pictures and that these no longer appear as conclusive as at first. One might for example begin to demur that the tile in Figure 5–1.1 is not exactly square but only shows a mass of little black dots. Where then would the difference be from Figure 5–1.3? etc.

I do not intend deliberately to introduce confusion, but only to indicate how this might be possible in principle here. Instead, I am more concerned with the next highest stage to which the established idea can be raised, that of expressing it generally in statements. Hereafter, instead of 'tiles', I shall refer to 'phenomena' (*Erscheinung*, Tr.). What expresses itself in them I shall call 'principle' (*Gesetzmäßigkeit*, Tr.). What is under consideration, can, by using these terms, be described in the following set of four statements:

Form I

1. There exists a necessary connection between phenomenon and principle whereby the latter cannot appear without the former and vice versa.
2. In the phenomenon there is a principle, which certainly does not embrace all the components in the same way, but nevertheless, none of these must be missing.
3. The phenomenon shows a principle, but none of its individual components matter to it at all.

4. The phenomenon shows no principle.

In formulating these statements care was taken to ensure:

- that they include a very definite content in as short a form as possible
- that the content of one statement is not repeated in another and
- that taken together they form a whole.

If however one compares especially the third and fourth with the corresponding presentation in section 5.1, one may be struck by the fact that the latter still puts it more clearly than the above statements. And it is also possible to see why this is so: In order to fulfil even the third mentioned condition of the wholeness, a fourth is necessary: I must formulate all statements with which they are comparable from the same standpoint, so to speak. In the above case it is obviously that of the phenomenon itself. This is always the point of departure of statements, if not grammatically, in spirit at least. But this leads one to suspect that from another standpoint the same whole might also show other very different aspects. The following four statements are a possible example. They comprise the same wholeness, but in this case considered from the observer's standpoint:

Form II

1. I observe the whole principle of this phenomenon.
2. I observe in the phenomenon a principle, which I have recognised in the phenomenon itself.
3. Confronted by the phenomenon, I am reminded of a particular principle which I knew beforehand from elsewhere.
4. I can find nowhere in this phenomenon what I usually consider to be a principle.

In formulating these statements too, all the conditions mentioned above were of course observed. The fact alone that the same idea can be expressed in such a variety of ways in statements shows that with statements it is not possible to find the ultimate and highest form of the idea and that they are still only the various outer garments of the same thing. But it may also be clear that a still higher form is expressible neither pictorially nor verbally.

5.3 Foliation and fossil in the light of the idea established

So far we have followed the newly discovered idea to the point where it expresses itself as a pure faculty of our mind. We can again make use of the statements developed along the way as a tool for use with an outer reality. In taking the statements to be close to the reality in question, it is possible to decide with the help of the faculty just mentioned whether an inner relationship exists. Indeed, we can do this according to the same process of elimination with which we have already tested the statements themselves. We can do this, even though of course stones and verbal statements seem to us by nature to be very different from one another. So much so that they would in the external sense be in no way comparable.

We shall take first of all the statements in Form II. It is of course clear that foliation and fossil must also then be approached from the standpoint taken there, namely that I must take note of how the two appear to me as the observer. For this, some of the drawings in section 4 may be a help. Even so, it would be appropriate at this point to have to hand real rocks, because each drawing or photograph shows that right from the outset a process of abstraction has been used. This shows most clearly in that, in contrast to a real object, we can no longer actively examine an object that is portrayed, for instance by turning it over or looking closer at it through a magnifying glass.

Thus, Figure 4–10 shows some *foliation* on a piece of gneiss, a piece on which in the above sense a lot more would of course be discovered if one actually had it in ones hands. However, I can recognise the foliation in a certain regularity in the arrangement of the minerals, which immediately excludes the situation in statement 4. In recognising the foliation and that it is independent of the type of mineral, I do not find myself in the situation of statement 1 either. And finally, I would also be able to recognise the foliation perfectly clearly even if I had never seen it before. Thus statement 3 is ruled out and it is clear that consequently statement 2 applies in this case.

If however, I look at Figure 4–12 and describe what I can see there, not as *wavy forms* but as *fossils*, then this too is of course independent of the minerals. But it is not independent of whether I remember similar forms, be they living shells or other fossils of a similar kind. This exactly corresponds to statement 3. This therefore shows that the idea developed in the previous section can make a basic difference clearly visible just where pure sense observation as such proves no longer comprehensible.

Now we shall try to bring in the statements in Form I. However, to do this we must also change our standpoint and no longer ask how foliation and fossil appear to us, but what do both show in themselves? If, corresponding to the above result, we apply statement 2 to the foliation, we find to our amazement that no correspondence exists. Yet is it not completely inconsequential for the foliar nature of a rock if a piece is missing. And it occurs to us — readers may test this for themselves — that this time, statement 3 is appropriate for the foliation and statement 2 for the fossil, because with the latter a piece broken off subsequently really is missing!

Thus to summarise, the situation can be shown as follows:

I. Standpoint of the phenomenon	II. Standpoint of the observer
2. In the phenomenon there is a principle, which certainly does not embrace all the components in the same way, but nevertheless, none of these must be missing. ⇒ *Fossil*	2. I observe in the phenomenon a principle, which I have recognised in the phenomenon itself. ⇒ *Foliation*
3. The phenomenon shows a principle, but none of its individual components matter to it at all. ⇒ *Foliation*	3. Confronted by the phenomenon, I am reminded of a particular principle which I knew beforehand from elsewhere. ⇒ *Fossil*

In the light of our idea, the main difference between foliation and fossil is confirmed in two ways. But in addition something is revealed of what must lie right in the very nature of these two kinds of forms. They complement one another in a certain way. It could be concluded: What the foliation does when it enters our consciousness lies in the nature of fossil as such, and what fossil does on its way to our inner self is revealed as the inherent nature of foliation. And in that fossil and foliation are certainly the most important elements of form for all knowledge of limestone and schist/gneiss respectively, this conclusion also throws some light on the matter.

At the same time, in these observations of limestone and schist, we have come up against a boundary which gives us a presentiment of what awaits us on the level of a third plane of reality now to be explored. Neither a purely external sensory, nor a purely inner conceptual procedure gets us any further, yet we have experiences we can sense as 'real'.

One might ask oneself whether these insights are of practical use too. I would say that they have been used unconsciously for a long time everywhere where people are trying to draw conclusions about the earth's past from the rocks available today. How this is done in practice in the two areas under consideration will be shown somewhat more precisely in the following section in an attempt to gain thereby a little more consciousness in the third region of reality mentioned above.

Here however, I would like to raise the question of which of the two standpoints shown above is the more important for drawing conclusions about the earth's past. One might incline to the view: because natural science wants to keep to the phenomena of course, it must be the *Standpoint of the phenomenon.* If, however, one takes a closer look at the matter, it appears to be quite the reverse:

- What do fossils add to our knowledge of the earth's past? When, by looking at them, *we are reminded of living organisms,* we have at the same time memories of their habitats. And as we extend our resources of memory in this respect, from

generation to generation as well, these pictures and with them our concrete mental images of the history of the earth become ever more living.

- What does *foliation* bring to our picture of the earth's past? Indeed, we are not only restricted to connecting memory pictures with actual phenomena. It is also possible for us *to experience immediately something of the principle* of a phenomenon. When foliation has been grasped in this way, it can for example also come to our notice that in one place the plane does indeed suddenly go through a very definite bend. And from this we then infer a faulting event for instance, which we classify as *later* in comparison with the occurrence of the foliation.

Thus, I believe that it is the *Standpoint of the observer* which is the deciding factor for such conclusions. When we demand that Geology must find the key to the earth's past somewhere in the present, we also know at the same time where this is to be found, namely in ourselves.

6 Previous geological investigations

Over many decades, the ever increasing splitting up of geological sciences mainly into a more stratigraphic-tectonic direction on the one hand and a more petrographic on the other, has had the effect that apart from casual references, there are no publications which take both the areas being studied here into consideration at the same time, even though of course, they are not very far apart from one another spatially. Moreover, in the course of time, northeast Jura has become the domain of Basel geologists whereas the southern Black Forest has become the domain of those from Freibourg.

For the present considerations I shall pick out the most recent general overview and detailed study, as well as a few works closer to the theme which are concerned with problems specific to one area but would either not arise in the other in the same way, or would not even be manageable. A rough overview of the geology of the region as a whole was given in section 2.

6.1 Bergsee area and the southern Hotzenwald

R. Metz (1980) in *Geologische Landeskunde des Hotzenwalds* gives a comprehensive though readily understandable overview. In part 1 he reviews the history of geological research in Hotzenwald. The main reasons for this research were on the one hand mining interests and on the other the urge towards a completeness of the geological map. With works such as P. Merian (1831), J. Schill (1867) and M. v. Tribolet (1872) and many others, the most important question for the area had already emerged, namely the significance of all the many transitions of rocks into each other. Tribolet (1872) wrote 'This transition from one rock form into another could only have taken place by metamorphosis, that means through gradual alteration of the structure and position of individual parts of the mixture'. From this fundamental problem came ever more concrete questions, on the one hand about the temporal sequence of the change events and on the other about a classification of rocks according to their origin and not only according to how they actually appear today. In our century, mostly after 1946, D. Hoenes, K. R. Mehnert and R. Metz, working individually, as well as W. Wimmenauer, working in conjunction with many others, developed a more or less fixed picture which is supposed to partly solve the problem in question. (A general work of each of these authors mentioned is included in the bibliography)

If I now consider some individual works it will become clear how it is obviously in the nature of the subject itself that precisely the same basic questions repeatedly come to light in a new garb.

In Murgtal, which is comparable with the Bergsee area, B. Krützfeld (1980), partly following previous works, classified cordierite gneiss, plagioclase-biotite gneiss, pyroxene gneiss, calc-silicate rocks, marble, rodded gneiss as well as light and dark dykes according to mineral content, structure (massive, foliated or rodded), colour and so on. He supplemented his classification with a detailed record of the relationships in Wickartsmühle quarry (about 2 km south of Rikkenbach), from which originates a characteristic picture of their reciprocal relationships.

By far the most predominant rock type is cordierite gneiss, which is penetrated by a very variable number of light, metre-sized layers and veins often with more or less diffuse transitions, such as for example the piece shown in Figure 4–11. The most important mineral phases are biotite, plagioclase and potassium feldspar, as well as quartz in the light areas. The cordierite appears only in small remnants within pseudomorphoses, which predominantly comprise muscovite and chlorite (pinitisation). To some extent, the muscovite also forms a separate phase and in addition, small amounts of sillimanite, zircon, apatite and opaque ore minerals are to be found.

Plagioclase-biotite gneiss embraces a wide spectrum of gneisses which show no cordierite, are altogether somewhat more fine grained than cordierite gneisses and extend as far as quartzites. But in their occurrence they are closely associated with cordierite gneiss. They also transform sharply or gradually into the much less common pyroxene gneiss, which points however to the transitions to the calc-silicate rocks and ultimately to marble. Through all these additional rock types the spectrum of mineral occurrence is greatly extended and at the same time also illustrates the difficulty of making any clear distinctions at all. And this is without mentioning the various dikes and joints!

I. Lämmlin (1981) lays special emphasis on the efforts to determine the parent rock (for the most part greywackes with other sediments and migmatite) from all the different kinds of gneisses. For this, on the one hand he investigates rocks which in his own words 'are covered with the veil of anatexis and blasthesis' [melting and recrystallisation]. On the other hand he makes a total chemical analysis, in order, with the assumption that the changes were isochemical, i.e. having taken place without mass exchange, to decide on the original parent rock. Precisely because the assumption is first and foremost an

arbitrary one it has the particular effect that even with the results obtained up to now the last word has not been said on the matter.

In addition, S. Federer (1983) tries to give the physico-chemical conditions of the pre-Variscan regional metamorphosis and arrives at a temperature of around 630–670°C with over 4 kbar pressure. To support his assertions he uses not only a large number of common and trace element analyses on the whole rock and individual minerals, but also thermodynamic data and diagrams whose detailed explanation here would take us too far from our present discussion. Federer also adopts various other more or less well founded assumptions, in that, for example he assigns to the metamorphosis product under investigation certain mineral associations and not others, etc., so that here certainly things are still in a state of flux.

6.2 Ermitagetal and northeast Jura

The most readily comprehensible overview of the geology of this area is given in *Geologische Führer der Region Basel* by P. Bitterli-Brunner (1987). There is first a brief description of the rocks which occur, the stratigraphy or the series of layers showing a welcome ordering principle. For all the topics it contains, from the Permian to the Quaternary, a picture in large brush strokes is also put before us as to how we can imagine the surroundings at a particular time: as sandy desert, as open sea, as coral-reef coastline etc. Finally, tectonics is briefly explained, with the Rhine rift valley, the Table Jura and the faulted Jura as the main topics.

In all this there is no hint of the fact that the geology of northeast Jura had first of all to develop before it could stand before us in this relatively clear form. We can find something about that only in the specialist literature, for instance in P. Herzog (1956), who was the last to work thoroughly on the local area and who mapped it on the 1:25000 scale. After that it is mostly a case of only the serviceable mapping of the earlier geological publications (D. Bruckner 1764, P. Merian 1821 among others), there being no mining problems here. Further questions soon point towards a stratigraphic compilation embracing the whole area. As a result of this, questions must also arise of course as to the tectonic interrelations.

P. Herzog also gives first place to a systematic description of the rocks with stratigraphy as the ordering principle. He was able to collect much of it from the older literature. In contrast, a few questions of detail to do with events associated with the fault in the Rhine rift valley and the Jura faulting were more open. For this, some fault lines had to be much more precisely established. Now this sort of thing can happen in various ways. In certain cases, albeit rarely, it is possible to find direct evidence of a fault, for instance: 'The fault can be fixed quite accurately along the Wartenberg by the prominent colour change from grey-brown Dogger soil to that of the red Keuper marl.' (P. Herzog). But in no way is this necessary evidence for a fault. Without the prerequisite knowledge of stratigraphy it could of course be quite another type of contact between two rock units! And so it is generally much safer — and also the usual approach in areas like the one we are dealing with here — if supported just by one's knowledge of stratigraphy one intellectually concludes the existence of faults: 'As for this exposure of Hauptrogenstein, there is no known trace in the countryside of an abrupt change in contours, nor of any other sign that allows the inference that the hard limestone continues to the south. It seems more likely that it ends abruptly, perhaps at a diagonal fault. The uncertain area is a meadow and arable zone covered with scree amongst which Oxfordian and Callovian marls may outcrop. The highest Hauptrogenstein is again exposed only 200m east of the woodland edge. It cannot be brought into direct relation with the Hauptrogenstein south of the central pond. Thus, a fault must run between the two..' (P. Herzog, in reference to a detail of the cartography of the Ermitage). Here it is obviously out of the question that at the fault nothing faulted was found. Indeed, this sort of intellectual conclusion is much more convincing than just wild speculation or extrapolation, as could also be done in the Bergsee area.

What has been dealt with here on a small scale, were the problems of tectonic development topical for the Jura mountains as a whole in the last century. People have since tackled this long period more with the help of individual observations, with direct conclusions from them as well as with various 'plausible hunches'. For instance H. Liniger (1953) arrived at altogether ten phases of advance and retreat for the development of the Jura, two of them main phases. H. Laubscher (1980) went into the matter very differently. What was new here was above all a greater effort not only first of all to put together all the existing ideas and opinions but also to think really critically to the end. He himself said of this that he wanted to shake them through a sequence of sieves, each individual sieve representing different criteria. These comprise the surest possible observable facts on the one hand and very basic assumptions on the other. Of the latter, the principle of conservation of mass is by far the most relevant: A rock does not change its mass by itself during a more or less cold deformation! As to the precise way in which ideas that can ultimately be sieved come into existence, Laubscher does not give so clear a picture. Instead he says that one could at will produce 'a large number of them by computer according to stochastic principles'. This is really not his problem though, because earlier geologists have already produced rather a large assortment of ideas.

These are first of all arranged according to various criteria, forgetting nothing important. The criteria are on the one hand the supposed relationship of the mesozoic sediments to the crystalline base underneath (allochthonous and autochthonous) and on the other, the driving force: gravity or horizontal thrust from the Alps. As a result of the final sieving the long distance thrust hypothesis originally from A. Buxtorf (1907) ultimately remains. This states that on a completely passive basement rock the mesozoic sediments were folded by a long distance thrust from the Alps. That this did not take place further south has to do with the fact that the slippage plane for the thrusting, the anhydrite group in the Muschelkalk, tapers off just to the north and in addition the pile of sediments over the basement is thinnest.

6.3 Overall view

What should have been made clear with the comparison given in the two previous sections, is not simply the question of whether the picture arrived at is right or not, nor just the critical appraisal of the method. Neither was really possible because these were just brief indications. Rather should it have been shown how incredibly differently, from the questions and the method through to the answers, the two aspects relate to one another in the areas under investigation, and that all is 'somehow' called forth through different rocks which in fact in both areas — to express it somewhat in caricature — actually do nothing else than lie around and weather! I shall demonstrate that it is by no means a case of 'somehow'.

A difficulty of comprehension concerning the significance of this study can only arise if the reader has not taken into consideration to a sufficient extent the insights gained in the previous sections. There it was of course shown how in no way is it possible to uphold the naive idea that there is simply a percept fossil and a corresponding concept fossil. This could arise if the basic epistemelogical works of R. Steiner (1886 and 1894), in which it is pointed out that each experience has both a perceptual and a conceptual side, are taken simply as a 'research result' and not as a working method. Only on this basis can a special study as to how things really stand in the present case be of interest. With such a study too, as R. Steiner (1922) basically observed, it is clear that it is in fact incorrect to simply *'call limestone and schist objects in the same sense'*. A few important points in this connection will again be selected.

It goes without saying that over and over again throughout geology the question which is in the fore is: How did it all happen? In an area like Jura this can first of all be tackled by investigating the strata ever more exactly. By this one by no means gains only some abstract before-and-after relationships — these are anyway already given by sedimentology — but ever more living pictures of a great variety of landscapes as could have existed in the area at a particular time. Moreover, especially with tectonic questions, it is clear that an enormous amount can be gained solely with really thought through inferences. Indeed, one could even fall into the temptation of forgetting that in sense reality it is certainly not these which decide on what is fact but observation of the senses alone.

If on the other hand one wants first of all to experience directly the phantasy-stimulating effect of direct observation, then one only needs to look at such things as the above mentioned Wickartsmühle quarry. If one lets oneself become involved in the view for a while, from a distance, from close to and from various angles, then it is not difficult after a short time — because one notices the veins, streaks, transitions, relations of the various mineral grains to one another etc. — to form at will complicated and ever new ideas about origin. On the other hand though, it is almost impossible to sieve through this critically in the way suggested for instance by H. Laubscher: How can one for example draw up a balance of mass if one cannot even determine the present reference mass. Even if after laborious investigations it has been established how far the rock reaches downwards, it is still not known how much of it is missing on top! — not to mention that which existed before any particular event of change! I. Lämmlin (1981) described this as the 'veil of anatexis and blasthesis'. And thus in the literature any number of new ideas about transformation and remodelling can be found, all these with the hope of ultimately arriving at some sort of sediment logic, but without the prospect that it will ever be achieved.

And with that, as was indeed supposed to have been attempted in this section, perhaps an *inner effect* of the rock types observed can be summarised simply in the following way:

- *Limestone:* I experience the power through which, by thinking a thought right through to the end, I unfold into the world of the senses.
- *Gneiss:* I gain respect for the multitude of stimuli which outer sense perception can send into my life of thought.

7 Conclusion

As a conclusion to these considerations of limestone and schist, I would once more like to summarise the steps which have been taken so far. To this end, I start from J. Bockemühl (1987), in order to clarify what I have discussed here in the light of this *fourfold relationship to reality of man to the world.*

To start with in the work presented I tried to go into the areas under investigation as unbiased as possible. Sketching proved an especially welcome medium for guiding one's full attention onto a level concerned exclusively with qualities such as light, dark, rounded, angular, sharply defined, diffuse etc., to name but a few. By using it, one can observe in oneself something very much associated with this medium, namely a feeling for character, which, developing and enlivening itself, leads on to artistic forms.

In addition, however, one comes up against a boundary in that one notices that concepts, which were until now meaningful and full of content, suddenly no longer stand on any basis whatsoever. By the example of fossil and foliation, which represent such concepts, it was then shown how the lost certainty can be regained only by taking both of them seriously where they really belong, not in the world experienceable through the senses, but in that of thinking alone. What one can learn above all by doing this is exact *differentiation.* First, this goes for the concept itself, but it proves also to be important each time clearly to distinguish how a subject appears from one standpoint or another. Otherwise one becomes entangled in apparently insoluble contradictions.

With this — in the spirit of the above mentioned essay — the step from the *first* to the *second relationship to reality* was taken and the way ahead pointed out, which is supposed to lead ultimately to a *third.* In what followed (section 6), steps were taken along this way by showing how in fact an *experienceable* and *understandable relationship* exists between things we describe as *external* — limestone and schist — and things we normally experience as ruled by our own whims entirely within us, namely our alternating

attention to our own thought activity on the one hand and to the world of the senses which presents itself to us on the other. At the end of that section an attempt was made to summarise this relationship in two statements.

The step to the *fourth relationship to reality* still remains. However, this is not one immediately reachable by a scientific study. One can express it thus: We owe to natural science all that has so far developed of *human freedom on the earth,* because only through natural science has it been possible for man, with his consciousness to penetrate and illuminate what confronts him as otherwise completely alien to his being, namely outer nature. However, while today natural science is visibly losing its ability to convey to humanity as such an inner certainty as to its relationship to the earth — in that it gives up any striving for reality by *thinking in terms of models* or, in *purely having recourse to external applications,* it treats human consciousness as insignificant — this freedom is in increasing danger of being totally lost again. Only when science succeeds not only in renewing its task through and through, but also in deepening it more and more, will our life on earth now and in the future be able to develop in a way really in accord with man and humanity.

From this it follows that only if the work presented here contributes to someone strengthening and deepening his inner relationship to the earth a little in the direction of the dead world of rocks, can I also count the fourth step to be successful here. That step was put in the following way by J. Bockemühl (1987): 'Our attention is now directed to the path we want to follow with other beings on the earth towards a beneficial future.'

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Maps used for the Ermitagetal

Landeskarte der Schweiz 1:25000, Blatt 1067: Arlesheim.

Geologischer Atlas der Schweiz 1:25000, Blatt 1067: Arlesheim. Geologische Aufnahme von P. Bitterli-Brunner, H. Fischer und P. Herzog (1984). (The part used here is, with a few corrections, identical to the map in P. Herzog 1956)

Maps used for the Bergsee area

Topographische Karte 1:25000 des Landesvermessungsamts Baden-Württemberg, Blätter 8413: Bad Säckingen, 8313: Wehr und 8414: Laufenburg.

Geologische Karte 1:50000 from R. Metz (1980)

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Review: "Toward a Holistic Understanding of Place: Reading a Landscape Through its Flora and Fauna" by Mark Riegner

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I am indebted to Mark Riegner for drawing my attention to some important contributions to holistic science which are currently being made by the development of phenomenological approaches in the spheres of architecture, environmental design and related fields. Phenomenology offers the possibility of linking many disciplines, of bridging the gap between art and science, while encouraging rigorous thinking and accurate observation.

The above essay appears as one of thirteen contributions in a recent publication, *Dwelling, Seeing and Designing: Toward a Phenomenological Ecology,* edited by David Seamon. These, together, explore many facets of the way in which man dwells in the world and cultivates the relationship to his environment. In earlier days, the spirit of place, its *genus loci*, could be appreciated intuitively. Those who dwelt there sought to live and build in harmony with the spirit and intrinsic character of their environment. Today, planned environments and utilitarian philosophies leave little room for deeper considerations. There is a need for new, more enlightened ways of seeing and heightened awareness — so that human experience becomes an essential factor in the design process.

Martin Heidegger's description of what it means to have the experience of being-in-the-world, in *Poetry, Language and Thought,* has inspired many phenomenological investigators. Before planning or building, an attempt should be made to experience, directly, the requirements and concerns of the local community and the underlying qualities of the landscape. The built environment should mirror the worlds and aspirations of the people who live in that environment.

Subjects discussed in this collection of essays include: the importance of a sense of place in relation to psychological and social well-being; the role of architectural features — porch, roof, door, window — in creating a reciprocity between building forms and human experience; and the social and spiritual aspects of the Findhorn Community.

Mark Riegner's essay, *Toward a Holistic Understanding of Place: Reading a Landscape through its Flora and Fauna,* has some innovative features and makes a distinctive contribution to the general discussion. "To 'read' a landscape, the student must prepare inwardly to be receptive to the whole, to be moved by it, and to approach the details with the attitude that each is a gateway to something more than itself."... "...a fragment, or part, when approached phenomenologically, becomes a revelation of the whole that

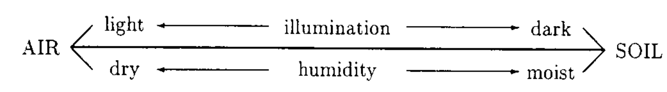

Figure 1: The polarity between air and soil.

informs it." Reference is made to Henri Bortoft's work on wholeness and the Goethean method.

Riegner applies the Goethean mode of observation to develop a way of reading plant and animal forms as expressions of the qualities that characterise a particular landscape. Plants can serve as indicators of the soil chemistry, moisture content and thermal regime of their environment. On a global scale, different plant associations occur in different geographical regions, such as desert, tundra and rain forest, and they indicate the climatic and geographical conditions of those areas. However, each of these is not a homogeneous entity but is made up of a variety of local areas, each with its own conditions of humidity, shade, wind exposure and other factors. On the north coast of Tenerife, for example, vegetational variations are related to conditions of solar radiation, wind exposure and precipitation, which are markedly different on north- and south-facing mountain slopes: sparse vegetation on south-facing slopes stands in marked contrast to luxuriant growth on the adjacent north slopes.

"Every plant bears the signature of the place where it is found." Plants of a particular species will tend to exhibit contrasting growth habits in different micro-environments, while different plant species tend to grow similarly in the same place.

Goethe noted that "the same species of plant develops smoother and less intricately formed leaves when growing in low damp places, while, if transplanted to a higher region, it will produce leaves which are rough, hairy and more delicately finished." It has also been observed, by J. Bockemühl and others, that the leaves of a plant frequently show an increasing differentiation from the basal leaves upwards, the upper leaves being more elaborately formed and incised. Riegner has extended these relationships and developed the general concept of Polarity between Air and Soil. The plant meets the qualities of light and air as it grows towards the sun, and those of darkness and moisture in the roots. Figure 1 indicates the contrasting relationships to illumination and humidity at the two — Dry and Moist — poles.

In extreme environmental conditions, the entire foliage of a plant may exhibit either the Dry or Moist quality, for example, dry qualities in a desert or moist qualities in a tropical rain forest.

Trees of the same species, in the same locality, may grow in different conditions of illumination and humidity. Figure 2 indicates how sun leaves are smaller and more differentiated, compared to shade leaves.

In general, rounded, less-differentiated leaves appear near the base of a plant, highly-incised forms in the upper parts.

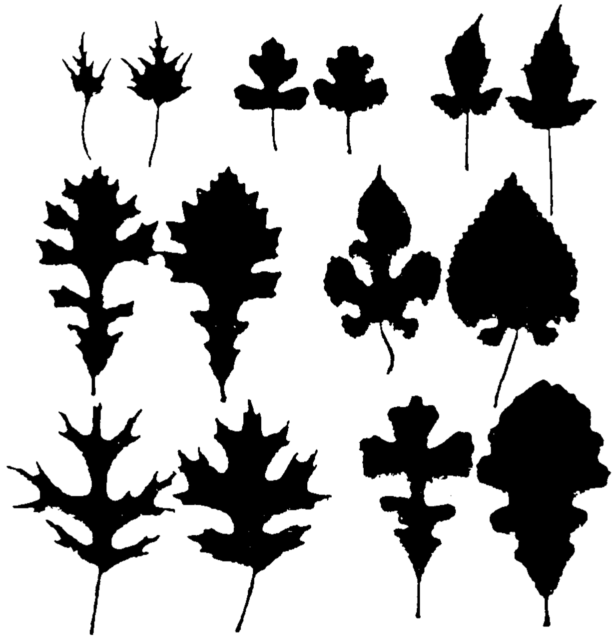

Figure 2: Sun and shade leaves from seven representative species of deciduous trees from the foothills of the Rocky Mountains. The leaf on the left of each pair is a sun leaf; on the right, a shade leaf. (Based on Talbert and Holch (1957), p. 656.)

If plants are in harmony with their surroundings, does the same apply to animal life? Many animals resemble their environment in regard to colour, pattern and form. Closer observation reveals many more inter-relationships. Mammals may be conveniently grouped as: rodents, carnivores and ungulates, each with characteristic features. However, these features become modified in different environments. Creatures inhabiting wetlands tend to have heavy-set bodies and simpler forms compared with similar terrestrial species.

The white-footed mouse and the woodland vole both inhabit forests in the eastern United States, although they occupy different niches in this environment. The vole burrows through the forest floor and seldom comes above ground, while the mouse scampers through bushes and trees. These rodents evidently represent a polarity, in form and behaviour, of the dark/moist, light/dry type. Many other examples of this polarity, in mammals, are given.

In general "the flora and fauna themselves constitute, in part, the landscape, which exists as an organic whole."

The North American prairie is noted for its uniformity. This quality is observed in both the vegetation and the animal life. The prairie gives the impression of a homogeneous flora, but it is actually composed, mainly, of many different species of grass, which require close examination for identification. In a similar way, the bird population includes a variety of species of sparrow which are very similar in morphology and colouration.

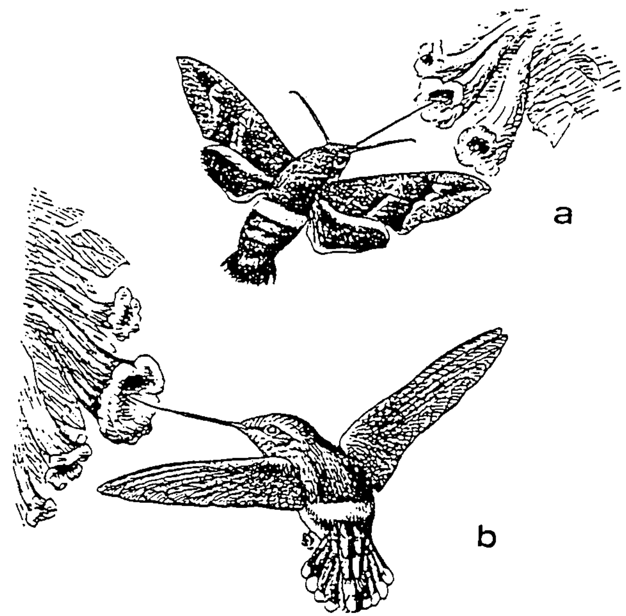

Figure 3: Similar morphology and behaviour in (a) sphinx moth and (b) hummingbird. (From Suchantke (1982b) p. 215, and used with permission.)

Different life forms may exhibit similar morphologies and behavioural patterns. Figure 3 shows how the sphinx moth and the hummingbird reflect a common motif.

Distant, but climatically and geographically similar, environments may show similarities in the flora and fauna, even though the species are different. Some striking resemblances between the forms of mammals found on different continents are shown in Figure 4. Similar observations have been made in regard to avian species.

In the course of his essay, the author brings together aspects of the work of: Adams, Bockemühl, Bortoft, Lehrs, Schad, Schwenk, Steiner and others.

In days gone by, indigenous communities probably had an immediate experience of the quality and wholeness of their environment. Riegner shows the path to a re-gaining of that experience, at a higher, more conscious level.

It is of particular interest that this ecological study appears in a volume written, mainly, with architecture in mind. Riegner's contribution stands out, for me, as providing a basis for further development in several directions, linking phenomenology, Goethean science, other current holistic trends and the various avenues opened up by Rudolf Steiner.

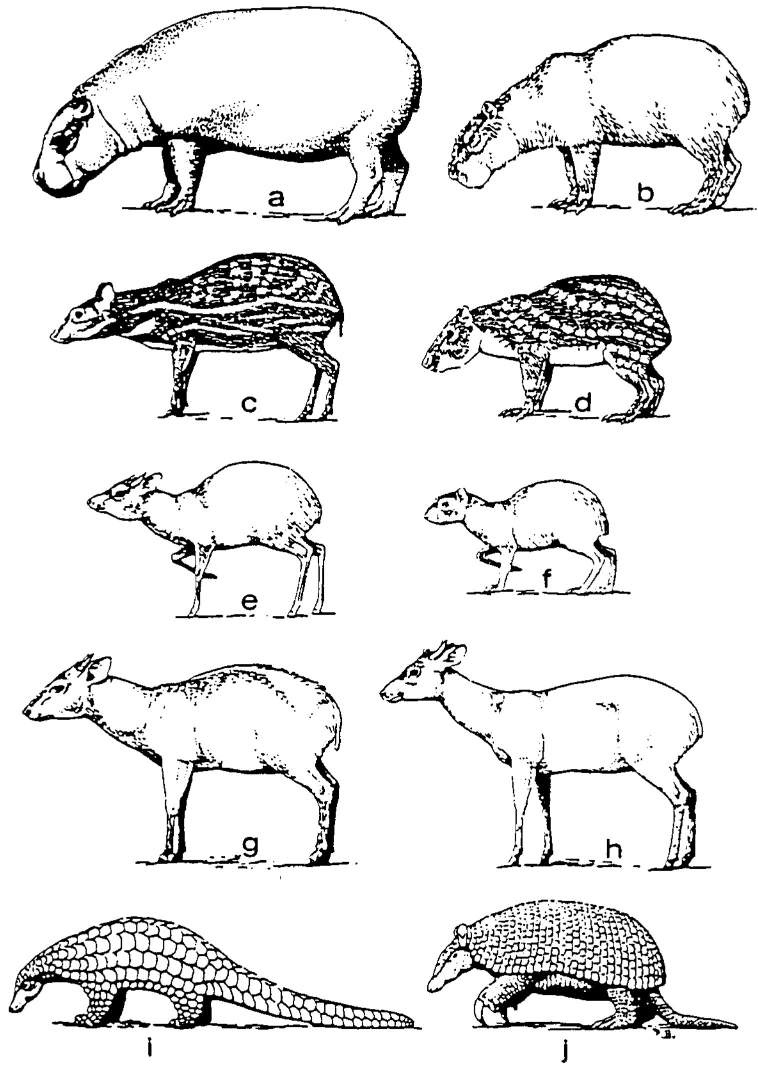

Figure 4: Mammals with parallel morphologies. Those in the left column are African; those in the right, South American counterparts: (a) pygmy hippopotamus; (b) capybara; (c) chevrotain; (d) paca; (e) royal antelope; (f) agouti; (g) duiker; (h) brocket deer; (i) pangolin; (j) giant armadillo. (From Suchantke (1982b), p. 389, and used with permission.)

Can the World of Quantum Physics Teach Us Something about the Trinity?

Michael Friedjung

In this short article I shall do something rather risky. There is a story about the great mediaeval teacher Alain de Lille, called 'Doctor Universalis.' He was walking on the banks of the Seine in Paris in 1168 the day before he was due to talk about the Trinity. He saw a small boy, who was trying to put all the water of the Seine into a small hole. When Alain de Lille told him that what he was trying to do was impossible, the boy replied that it was also impossible to speak about the Trinity. According to the story Alain de Lille was so moved, that he abandoned teaching the following day.... What I shall do is to indicate what appears to be a connection between two fields, which are normally thought to be widely separated. After briefly summarising conclusions in previous articles of mine about the nature of quantum physics, reasons for believing in such a connection will be indicated.

The world studied by modern physics is a world of the interaction of physical phenomena with instruments of measurement, that is between matter and matter. A long road has been followed in the history of Physics, which has brought it into a world very far from direct human experience. It is in this world that quantum mechanics must be invoked, when events over very small distances or involving very small energy differences are considered. As I have endeavoured to show for instance in the article "Towards a Spiritualised Science Concerned with the Beings Around Us" (*Elemente der Naturwissenschaft* no 41, page 35, 1984 and *Science Forum* no 6, page 10, 1986), we can begin to at least partly understand the nature of quantum mechanics, by considering that it studies a domain where elementary conscious beings exist. It was reasoned that consciousness exists everywhere in the universe and when more than one conscious being exists, it cannot completely predict or control the activity of other beings. However in the domain of quantum mechanics, the different beings resist each other. What would correspond for human beings to feeling, has there become a constant of physics! In fact it is possible to conclude that it is an inhuman almost 'dead' world; such a world without human feelings is in the language of anthroposophy that of a being called Ahriman, who is one of the adversaries of Man. In this world we can say that consciousness has been modelled by him. We can also understand this world containing quantum mechanics, if it is thought to be a world *below* Nature as experienced by humans, that is a world of sub-nature. That world partakes in and acts in the world of human experience. Indeed the world perceived by incarnated Man and where he acts, then can be conceived of as being between higher worlds and that of sub-nature.

Nevertheless, Ahriman is not a creator. He may be thought of as a dragon, who has corrupted things, but even in this corruption a reflection should still exist of creation. In addition modern Man must fight this dragon, but if he is strong enough to win, he can as in certain legends, obtain as a reward a treasure guarded by the dragon.

Before proceeding further let certain arguments be recalled. In the domain of quantum mechanics there is a certain amount of indeterminacy. Classical physics, which was known before the discovery of quantum theory, was deterministic; when enough sufficiently precise measurements had been made of a physical system, it was at least in principle possible using known laws to predict its future (in fact it is now known that even according to classical physics, what will happen to certain types of system is extremely sensitive to their physical conditions, so such systems are in practice unpredictable). According to the Heisenberg indeterminacy principle of quantum physics, it is in principle impossible to make all the necessary measurements with infinite precision and at least according to the orthodox interpretation of this situation, all the quantities to be measured do not even exist with such a precision. In fact a physicist can only predict *probabilities* of certain types of event occuring. As a result of Heisenberg's principle it is not possible to determine with more than a certain accuracy the position of a particle multiplied by its momentum and so according to the orthodox interpretation mentioned, these quantities do not even exist with more than that precision. The same is true for simultaneous measurements of energy and time. One way of stating the last result is

$$\frac{1}{\Delta t}\cdot\frac{1}{\Delta E} \leq \frac{2\pi}{h}$$

where Δt is the limit to which time t can be measured, ΔE is the limit to the precision with which energy E can be measured and h is the fundamental constant of Physics called Planck's constant. This expression can according to the reasoning of my previous writings be understood as due to the resistance between very elementary conscious beings associated with or behind a studied phenomenon and those associated with the instrument of measurement. One being limits something corresponding in a primitive way to the quantity of relevant knowledge needed before acting to produce a result ($1/\Delta t$) and the ability to act precisely enough to produce this result (corresponding in a primitive way to $1/\Delta E$, remembering the significance of energy in elementary physics) of any other similar being. The desirability of any result which can be produced by such a being for it, proportional for a being of this type to this quantity of knowledge which it possesses, multiplied by its ability to act (desirability is something which for Man would be connected with his feeling) is limited by the other similar beings with different desires, to not exceeding the constant $2\pi/h$. This resistance also explains fundamental properties of atoms as conceived of in today's science. In addition it should be pointed out that in such a type of physics time and space do not have the properties they have in the everyday world.

When a physical measurement of an entity of quantum mechanics is made, only some of the possibilities of this entity are realized. Certain of the properties of such an entity resemble those of a particle, while other properties resemble those of a wave. The

probabilities before the measurement can be calculated taking account of the latter fact. What is called the wave function is said to 'collapse' as a result of the measurement and it is necessary to take the particle aspect, associated with concentration in space, also into account when this happens. There have been many arguments about what this can mean. A few physicists have claimed that the consciousness of the experimenter making such a measurement causes the collapse. This is almost certainly wrong; it seems rather that what is responsible is the *interaction* between the phenomenon studied and the apparatus used for measuring. In fact what appears to be the best way of understanding what happens, is to consider that collapse occurs at least after an interaction, whose consequences are in principle measurable in the physicist's laboratory. After such an interaction, the system will again evolve in a similar way as previously: probabilities of various possibilities occurring can again be calculated.

What is the spiritual significance of what is called the collapse of the wave function? In a talk given in January 1991 by Nick Thomas to the Science Group of the Anthroposphical Society in Great Britain, he described the results of a study of this collapse by a physics study group. He associated the situation before the collapse with the being called Lucifer in the language of Anthroposophy, who is an adversary of Man and who among other things may be thought of as trying to make Man escape or expand (to become 'spread out') into a false spiritual world. Interaction was associated with Ahriman, that is a kind of death in particle-like behaviour, while what happens afterwards, similar in a certain way to a resurrection, was associated with Christ. These ideas stimulated me to think about such questions. I shall however present here another way of looking at them, according to which Man's adversaries are not creators.

In Rudolf Steiner's *Foundation Stone* meditation, the first three parts are about the Trinity. Each reaches a climax with Rosicrucian statements about the Trinity. These statements are *"Ex Deo nascimur"* (the Father), *"In Christo morimur"* (the Son) and *"Per Spiritum Sanctum reviviscimus"* (the Holy Ghost). In fact it is possible to see a kind of reflection of each of them in the process of quantum interaction. Before interaction we have the created world of the Father *(Ex Deo nascimur)*, in interaction there is a kind of death in particle-like behaviour or a sort of crucifixion with particle tracks *crossing* each other *(In Christo morimur)*, while there is again life after the interaction *(Per Spiritum Sanctum reviviscimus)*. This means that even in the world of Ahriman something remains of basic cosmic processes. Let it also be noted that in the second part of the *Foundation Stone* meditation, it is said that

For the Christ-Will in the encircling
    Round holds sway
In the Rhythms of the worlds, blessing
    the Soul.

This means that the Christ is present in the rhythms of the world and repeating interactions can indeed be thought of as defining rhythms. Before each interaction what was associated with the Holy Ghost in the previous interaction becomes associated with the Father in the new one.

The beings of sub-nature are not the only ones which exist. Interactions and meetings, as well as what precedes and what follows them, exist between many different types of being. If other beings are present in something which in the relationship between any two beings, is beyond the control of either one, we can start to understand the Trinity as consisting of Beings of a universal nature. Christ is then the Logos or Word pronounced during all encounters of beings.

Man is a being who can say "I am," that is one who is able to encounter *himself*. The importance of Christ when beings with this ability interact or communicate, cannot then be underestimated. It is with this kind of thinking also in connection with the meetings which take place in human society, that it may be possible for us to win a treasure guarded by a dragon.

(*Note:* After being consulted, Nick Thomas has asked me to add in a note that this article quotes his ideas accurately, but in his own words "of course do not fully convey why I came to the conclusion I did, and which I still hold.")