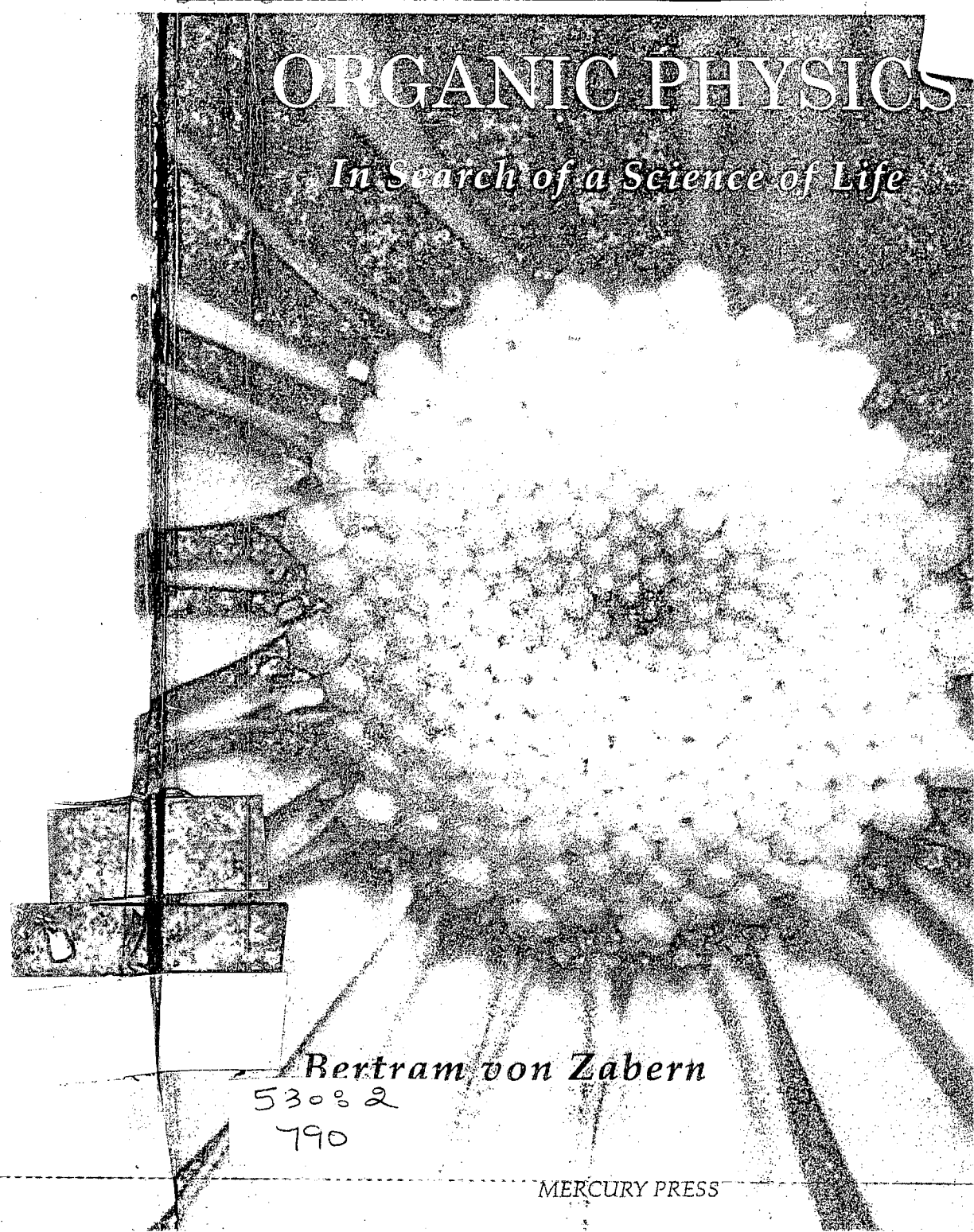
Has modern physics become estranged from life because of its methodology? Is it possible to rethink physics from its foundations and experience it as a science of life?
Dr. von Zabern, a physician, approaches these questions with self-observant thinking as it was proposed by the philosopher and seer Rudolf Steiner. When thought is meditatively enhanced, it reveals its own life. Setting out from this stepping stone, the reader is invited to join the search for new concepts of time, space and movement, and to explore the field where human activity brings forth — and overcomes — physical force. As unusual as the quest may seem to be, as old are the sources of such future physics, highlighted by the author with a series of biographical notes of spiritual pioneers from antiquity to this century.

MERCURY PRESS

ORGANIC PHYSICS

In Search of a Science of Life



Bertram von Zabern

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by
Bertram von Zabern

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World-cognition, self-cognition:
From the one towards the other
Soul's deep longing swings and questions.
Answers often seem to greet her
Solving mysteries of being:
Yet the next turn of the swinging
Generates from the solution
Just another basic riddle.
But when rather than in world-cognition
Searching for the grounds of being,
And rather than in self-cognition
Searching for man's true existence:
She seeks selfhood in the wide world,
And within the self the cosmos;
She does not yet reach the goals
Of wisdom; but she will find ways
Into the *life* of knowledge: soul-sustaining,
Spirit-heightening, world-revealing.

Rudolf Steiner

In the "Golden Book" of the Berne Free Students,
Berne, Switzerland, October 20th, 1920

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SPACE: IDEA AND REALITY

THE LIFE OF MOVEMENT

THE ELEMENTS

Preface

The last fifty years have taught that physical science affects not only our individual lives, but also the total life of the earth. Physics has become the prototype of sciences. Life and consciousness are interpreted as the tail end of a gigantic evolution governed by physical laws and chance; therefore they are predestined to be the last phenomena to be understood by physics. On the contrary, closest to a scientist is undoubtedly his own mind. The question of how conscious life and physical activity meet is existentially human.

So far, the conventional science has been unable to explain phenomena of life or consciousness. While physics is obsessed with mathematical calculations of particles, it tries to operate with an outdated concept of force and an inadequate concept of time. Its perspective has become constricted to the particle world where the conservation of energy principle may have limited validity; but the reality of a renewing world was lost.

The attempt to understand borders of physical, living and conscious action, as offered in this book, is based on Rudolf Steiner's ideas. Such borders constitute a field of science of their own, capable to shed light on adjacent areas of physics, medicine, psychology and other sciences.

Although mathematics promises so much clarity, it leads science merely to probabilities. Any logical order of phenomena allows for a materialistic as well as for a spiritualistic

interpretation. Whether or not an insightful being is capable to bring forth material content out of the physical nothing, matters deeply. These questions are unavoidable for modern physics. Their answering calls for a certainty that is neither provided by mathematics nor by logic.

All certainty, especially that concerning physical phenomena, originates in meditatively enhanced thinking. Therefore this workbook is dedicated to the reader who strives for self-observation of thought, based on theory of knowledge. Creative thought is indispensable for the true understanding of physics, and it guides it to become a science of life.

In the field considered here, different viewpoints are needed to come to new observations. May the reader find in the views of the following presentation some aspects toward exploring "organic physics".

Warmest thanks I owe to Arvia Mackaye Ege for her untiring encouragement, to Martin Askew for his help with the English version, and to my wife, Barbara, for her incessant support. I gratefully acknowledge the collegial effort of Dr. Gerald Karnow and the other coworkers of Mercury Press to make this publication possible.

Bertram von Zabern
Wilton, New Hampshire
November 1995

ARISTOTLE's teachings meant to Galileo nothing but an obstacle to scientific progress. His astronomy, perfected by Ptolemy, had become a powerful tool of the Catholic church. Incorrect statements dominated the traditional teachings. Would Aristotle not have been the first one to agree with Galileo? Had he not long before postulated that all theories be corrected and expanded by observation? Nevertheless, a profound difference of thought separated the two geniuses. Galileo considered mathematics the key to scientific knowledge. For Aristotle, that key was organic thinking.

Aristotle
384-322 B.C.

Detail of
Raphael's Painting
"The School of Athen

As the son of a physician at the royal court of Macedonia, Aristotle may have experienced early in his life the therapeutic connection between the elements of nature and the functions of the human organism. Seventeen years old, he became the pupil of Plato in Athens, where he stayed for twenty years as a disciple and teacher. After Plato's death, Aristotle went to live in Lesbos, and, as a teacher of

Alexander, he resided at the court of Philip of Macedonia. Alexander's reign overthrew the old Eastern empires in a magnificent attempt to unite, under the influence of Greek culture, the nations of the ancient world. The Lyceum, which Aristotle had founded at the same time in Athens, attempted to unite all areas of human knowledge into one unique system of science.

A major part of Aristotelian writings was probably originally taken from notes written down by Aristotle's disciples while he was teaching. Many, if not most, of these works were lost before Andronicus of Rhodes in 70 B.C. was able to prepare a complete edition of Aristotle's works. The Athenian schools of Plato and Aristotle had existed for 800 years before they were closed by the Roman emperor Justinian. Only a few writings, such as the Logics, found their way into the monasteries of western Europe in the early Middle Ages. It is said that Christians of the Syrian sect of the Nestorians were the ones to bring the works of Aristotle to the Arabian schools of Baghdad and Gondishapur in the 9th century. These writings contributed to the highest perfection of Arabian science and, through Avicenna and Averroes, who were both physicians and philosophers, were exerting new influence on Western thought. However, Aristotle's works had gone through adaptations to Islamic thinking. This led to a violent controversy between the scholastic Thomas Aquinas and the school of Averroes. The ancient texts were retranslated and, through the work of Aquinas, integrated into the Christian system of teaching.

A world in which each detail becomes part of a whole, in which each incident becomes part of an evolution, in which not chance but wisdom rules, such a world is an organism. Aristotle was in search of the living being of the universe and of the thinking human being within it.

ORGANIC THINKING

The Forgotten Science

More people today than ever before believe in the "big bang" theory of the creation of the world, in the relativity of all values, and in the universal power of physical energy. In a world which is saturated with chemistry and electronics, and threatened by atomic power, the longing for human wholeness has awakened. Man and the world have to be preserved as a unity of spirit, soul and body. Just how intensively this longing exists among particle physicists becomes evident through Fritjof Capra's bestseller *The Tao of Physics*. In his quest for the underlying structural elements of matter, the particle physicist reaches the boundaries of existence. Reality becomes relativity. Existence becomes the matrix of energy fields in space-time. For quantum physicists the world of particles is an indivisible unity that also includes the experimenting scientist, even though the connection between particle forces and consciousness remains obscure.

For Capra it is of decisive importance that parallel with the unity of the outer world there is an inner unity, as is described in oriental mysticism. He finds in this unity a source of ongoing joy and inspiration. The methods of particle physics, as well as the path of oriental meditation, penetrate into regions of extrasensory experience. Our sense-derived images and the words representing them are

not sufficient means to reach the foundations of nature. On a higher mathematical level that transcends perception and language, apparently incompatible concepts, such as the theories of the wave and particle nature of light, become united in dynamic wholeness. The New Physics of Capra attempts to overcome the dualism of spirit and body. It aims at an *organic* world view, where all phenomena become understood as parts of a harmonious whole. The question remains, where the bridge between the particle world of the physicist and the world of wisdom, coming from oriental mysticism, can be found. What place does human self-consciousness have in a world that transcends all human imagination and judgement?

In physics textbooks it is usually mentioned that the teachings of Aristotle prevailed for 2000 years, and that they were finally superseded by the development of the experimenting consciousness. The simplest observations, however, could have led to the realization that a stone weighing 20 pounds would not fall to the ground 20 times as quickly as a stone weighing one pound. Why, then, had people cared so little to correct these traditional assumptions? The architects of classical antiquity and the Middle Ages did not have the technological equipment of a modern engineer at their disposal. However, their buildings are by no means less stable than modern buildings and they exceed them in unsurpassable beauty. Did those architects have an insight into the workings of gravity and the power of levity that has been lost to our modern intelligence?

Aristotle had taught his disciples to observe nature. Every detail is part of a total creation. The solid, the liquid, air and fire elements lead gradually towards a spiritual cos-

mos. In the center of the cosmos is the earth, and man, who carries intelligence in his *heart*. The celestial bodies move according to extraterrestrial laws. Their movements originate with the Prime Mover. The Platonic and Aristotelian philosophers had knowledge of the living spirit of nature. What they saw as spiritual reality was closer to them than external observations of measurement, number and weight.

It is said that Galileo had his intuition of the laws of the pendulum while he observed the movements of the chandelier in the Cathedral of Pisa. Mystical thinking was replaced by mathematics and experimentation. A new world of natural laws revealed: crystal clear, rigid and lifeless. Newton made his revolutionary discoveries within a period of one and a half years while he lived in the solitude of his birthplace, having fled the Plague. "I found the method of fluctions by degrees in the years 1665 and 1666 ... In January (1666), I had the theory of colours ... and in the same year I began to think of gravity extending to ye orb of the Moon ...". The stars obey the laws of gravity. The cosmos moves by the iron laws of a machine neither God nor human power can interfere with.

The mechanistic school of thought had become a fortress, outside of which Goethe, with his theory of colors, found himself isolated and ignored. He left no doubt that his theory of light was incompatible with Newton's. Goethe was not interested in merely combining experimental data. His aim, rather, was to practice intuitive observation. The range of his observation included the sensory *and* the spiritual realms of experience. He saw mathematics as a tool of exact thinking, but not as the essence of natural phenomena. Goethe observed how each phenomenon is created by an archetypal

phenomenon. The archetypal plant brings about the different forms of plants, the archetypal light creates the colors and different shades of light and darkness. Goethe was able to see these archetypal phenomena in his spiritual observation. Thus he expanded the principle of observation to the spiritual activity of the researcher. — The mathematical-experimental method had become too far removed from the intuitive observational method of Goethe. On the one hand there was light as a spiritually creative power; on the other, light as dead corpuscles. Goethe's theory of colors was soon forgotten, whereas the particle theory, later known as the quantum theory, prevailed.

The organic science also grew through the works of several of Goethe's contemporaries. Through relentless research Novalis created the beginning of an encyclopedia of sciences, in the center of which stands the image of man. His writings were even less noticed than Goethe's. A breakthrough was achieved by Samuel Hahnemann. He had the insight that the effects of healing substances were caused by spiritual forces. The more these substances are dynamically diluted in their process of preparation, the more their healing power is freed. The poison of Nux Vomica, for example, becomes a remedy against nausea, after the extract of the seeds has been diluted gradually by rhythmic shaking. In the totality of the effects of the remedy Hahnemann found the counterpart to the archetypal picture of the corresponding illness as it appears in its symptoms. External observation and imaginative inner observation led him to the concept of the different *remedy pictures*, to the correlation between the symptoms of illnesses and their healing processes. Hahnemann had achieved the synthesis of inner and outer observation, congenial with

Goethe's natural scientific method. A science had come about that was able to prove its healing power in countless cases, thus contradicting the theories of atomistic physics.

During the intellectual struggles of the end of the last century, Rudolf Steiner developed a theory of science which was based on Goethe's method. The science of Galileo and Newton confines itself to the forming of mathematical concepts, but it does not include the thought life of the researcher in its field of observation. This thought life became the starting point for Rudolf Steiner's theory of knowledge. He recognized thinking as "the unobserved element of our spiritual life". We need the exactness of mathematical logic. However, the activity of thought contains a power that is not only logical but also creative. Because Goethe had recognized this spiritual power, he had been able to lay the foundation of a science of organic life. Rudolf Steiner saw in Goethe the "Copernicus and Kepler of organic life".

The Basic Concept of Physics

Modern academic training in natural sciences uses a wealth of technology and expert knowledge, which exceeds the comprehension of a lay person. Many years of training introduce the student to the mathematical and geometric thinking of physics and other sciences. However, the study of natural science includes very few attempts to understand the foundations underlying physical knowledge. Such questions are redirected to the fields of psychology and philosophy. One day the student may close his textbooks and ask himself: What is a line? Why do one and one make two? Do I understand the simplest process of my thought life?

I found myself in such a situation at the beginning of my medical training. At first, I was impressed by the perfection of the technical equipment and by the intelligence which had invented it. But that soon changed. I felt the chill of a research that was inhuman. At the same time, I met several young people who were studying Rudolf Steiner's theory of knowledge. This study, led in free conversation, awakened my enthusiasm through the clarity and energy of thinking. We experienced how amazingly little the objects which surround us are present in a concrete way because our thinking finds in the sensory world nothing but a collection of *impressions without their inner connections*. Seen from this perspective, the table, the wall, and so on, disintegrated into a sequence of visual, tactile and other impressions. We tried to experience the "world as perception". There was the old naive world in which I had grown up; however, it appeared to me increasingly unreal, once I had discovered the chaotic world of pure perception. One of the students realized that I was losing the ground under my feet. He advised me: "So far you have observed the percepts given to you without your contributing to them. That is only one side of reality. The other side is always present at the same time. In order to perceive it, however, you have to look into the other direction, into your own thought life. There you will find the conceptual content of external things. That conceptual content is as observable as the external percepts, but you have to look in the opposite direction to see it." Slowly I became accustomed to observing the other side and to making concepts the focus of my observation. The concepts of numbers and geometric figures gave me a source of insight into their living inner unity.

Exercises in the field of Rudolf Steiner's theory of knowledge began to lead me to a boundary which became difficult to cross. I had learned how to divide a naive consciousness of reality into perception and thinking. If the theory of knowledge is so powerful, would one not expect that it would lead us to completely new insights into the nature of the world surrounding us, e.g. to new laws of physics? Why was I fascinated by a theory of knowledge which does not go beyond analyzing? Time and again I read Rudolf Steiner's descriptions of *perception*:

> "What then is a percept? This question, asked in this general way, is absurd. A percept emerges always as something perfectly definite, as a concrete content. This content is directly given and is completely contained in what is given. The only question one can ask concerning the given content, is what it is apart from perception, that is, what it is for thinking. The question concerning the *what* of a percept can, therefore, only refer to the conceptual intuition that corresponds to this percept."

If thinking exists apart from sensory percepts, then these percepts exist outside thinking. How can my mental activity attain to something which is beyond it? Impressions like red, light, dark, sound, touch come and go without revealing what they are. They are foreign to me: "Out there is something, which I am not". The boundary line where common logic appeared to end, began to attract my interest. Here was an area that was taboo to formal thinking, for how can I understand something that exists outside of me? I would have to break through the boundaries of logic and hurl my mental activity beyond itself. In doing that, I would risk losing my mind. It began to dawn on me that a concept lives in the dynamic of my thinking, even before it assumes the shapes of mental pictures and language.

In comprehending, thinking, and doing, I could experience my own presence. Impressions such as *light, solid, loud* came to my attention, but they could not become identical with the experience of my self. To allow them to be present, I had to give up my self-perception. These were impressions which came and went without continuity. Within this field of observation, there was a content I had overlooked because of its simplicity. "Out there is something foreign, which is not me", was more than a confession of my ignorance. It was a clearly comprehensible reference, synonymous with itself, full of life, yet clearly structured, pointing beyond myself and itself. *The concept of the external* presented the same kind of unity which I experienced in myself, though it was not confined to the limitations of my person, because it arises wherever thinking addresses itself to outer objects. The more I consciously perceived colors, sounds, impressions of solid objects, the more I recognized within them the *external*. The latter I realized as a quality of its own kind, similar to *red* or *solid*. The experience of the *external* was especially intense when I woke from sleep or was caught by surprise. Most of the time the quality *external* was as inconspicuous as the foundation of a house.

These and similar exercises in the observation of the life of concepts, such as they have been suggested by Rudolf Steiner's *Philosophy of Freedom*, gave my thinking the new direction I sought. The concept of the external lies at the roots of all physical, geometric, and even mathematical concepts. It is the foundation of the natural sciences. Therefore I regard it as the starting point of a science of the outer world.

With the introduction of the concept of physical force, Newton laid the foundation of the scientific world view that was to prevail through the following two centuries. The same lawful connection of force, mass and acceleration was to rule all terrestrial and stellar movements. In the force one saw the cause of all activity. The mechanistic dogma prevailed so strongly that 19th century materialism took on the dimensions of a world religion. — Newton had no doubt that a force is needed to set an inert body into motion. Therefore he did not search for the true nature of that force but rather was interested in the mathematical ratio between the inertness of the objects and their state of motion. Physics became entirely interested in quantity. Newton's "force" was, from the beginning, a mere definition, the content of which nobody was able to observe. Thus it is not surprising that contemporary physics, too, offers no understanding of the reality of an external force. This is made clear in a passage in Wilhelm Westphal's textbook of physics (1950): "Therefore it would be incorrect to state that in nature there is the reality of something like forces. There are only — many different — conditions under which a body receives accelerations, that means equal effects. The concept of force is merely a congenial human invention that makes it possible to explain the totality of the accelerations in a uniform way, while the question about the real cause is postponed by inserting the concept of force as an abstract cause." Thirty years later, Capra's book reports: "In the subatomic world there are no such forces, but only interactions between particles, mediated through fields,

that is, through other particles. Hence physicists prefer to speak about interactions, rather than about forces."

Living Thinking. Through Rudolf Steiner's theory of knowledge it became possible to search for a concept of physical force in a new way. The ordinary intellect has proved unsuited for gaining an understanding of the true nature of physical force, because it gets lost in trying to bring the phenomena into a mathematical order without being able to perceive its own inner activity. In order to arrive at meaningful physical concepts, the activity of thinking has to be intensified. By means of the path set out in Rudolf Steiner's theory of knowledge, the observer can learn to perceive his own thinking. In so doing he takes hold of the instrument for creating dynamic concepts and is able, in a new way, to come closer to an understanding of the concept of force. The observer has to postulate a *concept of force which can extend literally to reality,* something that takes place only at the very point where the concept itself becomes physical force. Logical thinking will object that a concept cannot extend to a place where it is no longer a concept. But our investigator discerns the weakness of mere logic that becomes trapped in definitions instead of recognizing its own origin. He reflects, "The number three is a unity, just as I am. My thinking is alive. In this activity of mine is an inner force which only becomes apparent when I *perceive* my thinking. Concepts are movements in my thought life; they become transparent to my inward perception." The observer comes to see that his conceptual life has its basis in a thought activity that is transparent to itself. All activities being thought through and seen through are concepts!

Outgoing Action and Withholding. Based on this insight, the researcher soon discovers that the concept of the external (page 12) has its own inner life: "Whenever my activity directs itself towards something that is not my doing, it develops both an outgoing and a receptive side. The more passively I let color, the feel of objects, etc., be present, the stronger becomes the experience that there is something external. These external impressions are able to reach me because I perceive them. Whatever touches me, I can touch. When I meet the external impressions actively, I reach out to them and beyond myself." The concept of the external starts to resound. Full of energy it reaches beyond itself and enters the outer world. In countermotion the conceptual life opens itself to the outer world and absorbs it, holding back its own activity.

Forceful Effect. Once the inner force of the concept is experienced, it is clear that it can bring about forceful effects when it is directed towards the outer world. The observer enters upon a new field of physical science. Physical effects caused by spiritual activity are unacceptable to the atomistically oriented physicist because they threaten his world view. For this reason the Goetheanistic researcher carefully tests each further step, "If I keep my outgoing action in view and then encounter an external object, something new takes place. I both reach towards the external impression with my activity and encounter it simultaneously. Like meets like. I experience the impression as a reaction. I feel a glare of light, an object blocks my way. My outward-directed activity presses against the obstacle and recognizes it as a forceful effect."

Following this path of knowledge the researcher gains several new insights into nature. In order to recognize nature, he does not have to completely reproduce it, but he must at least reach its reality. The power of a natural phenomenon reveals itself to him to the extent that he is able to take part in it. The forceful effects which emanate from him when he meets outer impressions may be inconspicuous, although they are really there, like other external facts. He does not only encounter outer objects with their resistance, but he also encounters, in more subtle ways, colors with his vision and sounds with his hearing. In each of these encounters an action emanates from the observer. His outward-directed activity comes as well from his inner self as the percepts reach his inner self.

Is the *outgoing action* the concept of external force? It is entirely of my doing, and hence apparent to me without the presumption of unknown energies. Many critics call this an anthropomorphism. Each thinking person is capable of turning his activity with insight towards the outer world, thus bringing about forceful effects in it. The concept of the outgoing action rests on its own content. It does not presuppose a human organism because it is eternal. The human being participates in the outgoing action creatively.

Emptiness. Despite these qualities, the outgoing action does not constitute a complete concept of force. It is only one aspect of external creativity. Any being constantly sending its activity outwards would dissipate itself unless it were about to find the way back to its inner self. The outgoing action therefore needs a counteracting conceptual activity. This counteraction consists of holding back the outgoing activity. It is the return of the active being to its own self. Spiritual life

withholds its activity from the outer world, hence depriving it of a forceful effect. Brightness is replaced by darkness, sound by silence and resistance by emptiness.

Equipped with the concept of counteraction, the observer turns towards the outer world. He enters an environment where no walls imprison him and where no daylight dazzles him. Where he wanted to demolish an obstacle with his outgoing action, he finds only cobwebs. He does not perceive the latter until he can tame his impulsiveness and probe forward with great sensitivity. The more he does so the closer he comes to the perception of emptiness. Instead of bringing about forceful effects in the outer world, his holding back induces external emptiness. Only then does he create the condition for encountering the emptiness of his surroundings. The observer perceives the external existence of emptiness as well as its inner origin.

Emptiness plays a fundamental part in the constitution of the outer world. It is an actively created element. Its quality reveals itself to the observer when he takes into account his active relationship to nature. Is emptiness a forceful effect? It does belong to what we call forceful effect just as shade belongs to light, cold to heat, or hunger to satiation. Once the nature of emptiness has been grasped through understanding the activity of withholding, emptiness can be recognized in its varied forms in external objects. As light and dark stimulate each other to create the beauty of color, so also is the spectrum of the natural elements generated by the polarity of forceful effect and emptiness. Water, for instance, consists of a different relationship between forceful effect and emptiness than does air. In the force of heat, which drives a locomotive, forceful effect and emptiness interact in a differ-

ent way from their connection in the iron out of which the engine was forged.

Force, Resistance. The mutual involvement of forceful effect and emptiness, which we call here *force* or *resistance*, manifests itself in each case as either stronger or weaker. Outgoing action and withholding emerge together at every moment from their origin and mingle with either one or the other prevailing. Structures arise in the outer world containing forceful effect as well as emptiness. If the forceful effect prevails, we talk about great force or strong resistance. If emptiness prevails, the resistance is weak. — To make a chair tip over backwards, I have to exert pressure against its back. I need not use all my strength because the chair does not offer much resistance. My excess force passes right through the chair's resistance; it is not used and consequently held back. At this instant my outgoing action encounters the forceful effect, and simultaneously my withholding meets the external emptiness. I recognize the relevant resistance as a mingling of forceful effect and emptiness. The closer the chair comes to tipping over, the smaller the resistance of the chair-back to my pressure becomes. Each moment more of the resistance disappears. As this happens, the outgoing action that meets the resistance withdraws more and more. The decrease in the external force is recognized. The opposite happens if one allows the chair to slowly tip back to its normal position. Then one observes a continuous transition from withholding into outgoing action because more and more new resistance is encountered. Increasing force is recognized. Getting weaker and getting stronger arise from the conceptual life. Every external phenomenon tends to become either stronger or weaker.

The interpenetration is more than the mere sum of forceful effect and emptiness. The urge to become stronger or weaker, and the increase and decrease in their degree of interaction, indicates a common origin where the outgoing and the withholding both come from active thinking. Something from this origin accompanies action and counteraction out into the external world so as to meet all transitions there in the process of recognition. It is the nature of every external object to have a polar structure, for it arises from the stream and counterstream of activity originating in the inner realm. Being stronger or weaker is due to whatever a force or a resistance is intrinsically. A strong force differs in quality from a weak one in just as a giant differs in his body proportions and behavior from a dwarf. If a certain external resistance is experienced and recognized by a human being, its intensity cannot be measured only in relation to other stronger or weaker resistances. Its proportion of forceful effect and emptiness is created by the observer, at least vestigially. The different degrees of alternating dominance by forceful effect and emptiness form a scale of characteristic force intensities or weaknesses. The weight of five pounds, for instance, has a unique quality of its own, as does a temperature of 37° Celsius or the tone A in music.

Conventional physics looks for the causes of properties of matter one-sidedly in the outer world. Such a science considers the concept of polarity unimportant and, in consequence, fails to understand emptiness. It regards darkness, cold, silence, and lack of resistance as nothing. This science is constructed on a few basic elements such as length, time, and mass, for which it has no further explanation. The basic unit of length, the metre, was originally defined as a forty-mil-

lionth part of the earth's circumference. For practical reasons it is now defined as equal to the length of a platinum-iridium rod kept in Paris at a temperature of 4 degrees Celsius. A basic entity is thus quantitatively derived from several secondary, more complicated entities. The same applies to the definitions of the units of time and mass or force. In order to be able to talk about stronger and weaker forces, the orthodox physicist has no choice but to first define a unit of force, which he then multiplies or divides. His entity of force is defined quantitatively by other entities but is not understood qualitatively.

Organic physics builds its basic concepts out of thinking. Its concept of force consists of its insight into the interaction between the force of thinking and what is external. The concept lives dynamically within the basic polarity of thinking and not-thinking. Without premature borrowing from what has not yet been understood, the polarity of forceful effect and emptiness reveals its range of stronger and weaker forces. As both originate in the same inner thought, a weak force calls by its nature for a stronger one, and vice versa. Only now does it become necessary to make distinctions in space and time. If a stronger resistance is overcome, a weaker resistance takes its place. A time sequence begins. If a weaker and a stronger resistance are together in the outer world, one is present where the other is absent; they are spatially adjacent.

ST. AUGUSTINE spent most of his life in the western part of North Africa near the Mediterranean coast. In his early years, he encountered in Carthage both the philosophical schools of antiquity and of his own time. He felt attracted to Manichaeism even though his mother had brought him up in the Christian faith. - Twenty-nine years old, he travels via Rome to Milan. There he finds Neoplatonic teaching as well as Christian spirituality. He experiences in a storm of emotions his conversion to Christianity. Shortly after his baptism on the Saturday before Easter in 387, he returns to Africa to devote his life to the priesthood. Living together with his friends, the first beginnings of a monastic community takes shape. — For thirty-five years he was bishop of the harbor town of Hippo and it was during this time that his written works, which were to become pillars of the Christian philosophy throughout the centuries, were completed.

St. Augustine
354-430

Detail of a painting
Piero della Francesca
Museo Nacional de
Arte Antiga, Lisbon

We know St. Augustine as the passionate confessor, as founder of Western monastic life and powerful Christian teacher in the turbulent period of the late Roman Empire and early Middle Ages. He was not a scientist, yet he has described the concept of time with unique accuracy. We learn from his "Confessions" how the soul remembers the fateful peaks and troughs in her life. She longs for peace in God. In

her search she journeys through all the realms of the sensual world. She looks into the depths of memory, and eventually climbs beyond the power of memory. What does the soul see? Augustine devotes the Eleventh Book of his "Confessions" to the concept of time. It is senseless to ask what existed before the creation of heaven and earth because the divine spirit is eternally present. Time comes about only with the creation of transitory things. What is time? A passage of time can be observed with the sensory organs, even if only in the present. The past and the future have no external existence. They are to be found in the soul realms of memory and expectation. The transitory present, if seen accurately, is only the moment when the future becomes the past. Hence time can only be observed incompletely with physical eyes and ears. It cannot be measured in the material present. Measurements of the rhythm of time are depicted only in the soul realm. In the last book of his "Confessions", Augustine writes about the Trinity. Man becomes aware of himself as a knowing, existing and willing being. These three capabilities are an image of the Trinity. In his work "About the Trinity", he describes these capabilities as memory, insight and will. He does not mention the connection between the three innermost soul activities and time. Nevertheless, Augustine's thinking indicates clearly that knowledge stems from the past, that contemplative existence lives in the spiritual present, and that will strives towards the future.

We find in Augustine's writings much of Platonic philosophy; but this thinking has undergone a change. Augustine is not a philosopher of antiquity walking through life at a harmonious pace. He is much more a desperate seeker who will pray in the moment of deepest humility. Knowledge is worthless unless it is transformed into love. Through human will the treasures of memory become good deeds. Time comes about through creative doing. In memory, insight, and will, we participate in the creation of time and make it good or evil. Augustine's concept of time is inseparably connected with human existence in the context of Christianity.

THE ENIGMA TIME

The Nature of Time

Although time is an essential component of all physical processes, contemporary physics has, to my knowledge, no clear concept of what it is. In textbooks at best references to different methods of measuring it are to be found. The concept of time itself is either ignored or else defined with Einstein as the fourth dimension of space. At this point the question about time's real essence, which nobody has posed more emphatically than St. Augustine, is no longer asked. In his *Confessions* Augustine refers in a clearly thought out way to the principal difficulty of measuring time. "For the interval itself we measure from some beginning unto some end. On which account, a voice which has not yet ended cannot be measured, so that it may be said how long or how short it may be; nor can it be said to be equal to another, or single or double in respect of it, or the like. But when it is ended, it no longer is. In what manner, therefore, may it be measured?" The problem cannot be solved by measuring movement because time is not the movement of a body. Augustine recognized the presence of time in his own contemplative activity, leading what comes from the future over into the past. The human spirit encompasses both smaller and greater periods of time; God's wisdom, however, has been familiar since eter-

nity with all temporal events. Augustine was able to discern the time's essence in the very ground of divine creation. He established a scientific perception of time in Christianized thinking.

The same thinking had led Novalis on new assumptions to understand time. His *Fragments* contain in the shortest of formulations an outline of time's nature as a component in an overall scientific system. Time is a consequence of spiritual creativity extending to the physical world where it produces things that are spatial. In its own more spiritual sphere, time has three counterdimensions correspondent to the dimensions of space in the world of objects.

Rudolf Steiner made far-reaching references to the nature of time. His sketchy outline of the concept of time in the chapter *The Goethean Concept of Space*, that forms part of his *Introductions to Goethe's Natural Scientific Writings*, is little known. There he points out for the first time that the basic element of time and space, hitherto overlooked, is separation or particularity. He left no doubt but that this is a phenomenon that is as perceptible externally as color, sound or warmth. — In his book *Occult Science, An Outline* Rudolf Steiner describes the origin of time together with that of warmth at the beginning of the earth's creation. Later, he characterized time as the sphere of all that lives. Each organism has its *time body* which, by means of its formative forces, fashions the spatial-physical body. Rudolf Steiner explains how the spiritual world forms three counterdimensions to those of space. — Time is always measured only according to spatial dimensions. It is a spiritual sequence of events that becomes comprehensible to us through thinking strengthened by imagination. Rudolf Steiner's work opens the way to

an understanding of the nature of time, such as Augustine had postulated, and Novalis had foreseen.

... *its Perception*

The phenomenon of *time* is interwoven with many other phenomena. Is time a phenomenon by itself or is it an abstraction? Initially, we form a naive picture of time as a stream of events moving steadily from the past to the future, with only the present externally apparent. The past is memory, an echo within us of external experience. The future is phantasy, a preparation for experiences that are yet to come.

Let us look more closely at our external perception: We have to admit that only fragments of the outer world are presented to us from time to time. Our field of view covers at best only half of the room that we believe to perceive clearly. The other half is remembered and imagined. This field of view provides us only with a small area of clear visual impressions together with a larger blurred periphery that includes blind spots. It is thus a narrow band of transient impressions in time, which gives us the experience of space.

How does a course of time manifest itself? The seed perishes in the sprouting process. There is no moment at which a complete plant is in front of us. Its development stages are in continuous transition. It is impossible to observe plant growth with the naked eye. We are content with fragmentary observations and create the transitions in our mind. What are these observational fragments like? As the plant sprouts, green appears where brown was hitherto. When a blossom forms, red replaces what was green; a brighter color takes the place of a darker one, or vice versa. A careful touch encoun-

ters resistance, where none was felt before. The polar phenomena of red-green, light-dark, resistant-yielding, are joined by the unnoticed phenomenon of appearance and disappearance.

Light, color, resistance are present as external experiences. Interwoven with these are appearance and disappearance, that is, external observations that in our case can neither be described as light nor as resistance. The more suddenly disappearance/appearance happens, the more clearly the observer is impressed by it. The emergence of a loud sound out of silence gives us a shock. So does an intense beam of light out of darkness and so, too, the sudden darkening of a bright room. Every appearance/disappearance is a connected process. We call such a sudden transition an *interruption*.

Interruption is an external phenomenon; but it would be nothing without its accompanying colors, sounds and resistances. A characteristic of an interruption is that it occurs always within the *polarity* of a phenomenon. Thus, initially, it does not separate a sound from a color but rather marks the transition from a loud to a soft sound, from red to green, from solid to liquid.

... its Concept

Just as in the old tales kings and beggars are equal before the Great Reaper, so are all earthly phenomena in the face of time. The arrival, presence and disappearance of external phenomena are themselves external phenomena of a higher kind. We therefore need to form a concept that is more original and innately more substantial than we have so far done

in comprehending external effects. In order to better understand what is normally a dulled experience of external interruptions, I would like to ask the reader to recall the content of the previous chapter.

Outgoing action and withholding both originate in common from the core of thought in order to form external forces. Although the outgoing action and counteraction can be grasped in picture form, their common origin offers itself as an unformed unity that cannot be easily imagined. This unity is filled with creative power. From this origin outgoing action and withholding emanate in all possible states of reciprocal dominance. The origin is constantly renewing its activities and tends continually to change their interrelationship. This is the starting point for understanding time. When the action emanating from the origin is predominantly outgoing, a stronger effect comes about in the outer world. This disappears when the origin holds back most of the outgoing action, producing a weaker external effect.

A person whose inner origin led him to withdraw all activity, that means outgoing action *and* withholding, from the outer world, would give the appearance of being dead. If, to the contrary, his inner core were to completely surrender to the outer world, he would lose his consciousness of self. In between these two extremes the pendulum of time becomes visible. Anything which disappears externally leads us back to the inner origin. If this happens suddenly, we are shocked. In realizing how the inner origin withdraws, we discern the essence of an interruption in time. When we observe how the creative force out of its origin continually renews what is external, we discern time's duration.

The basic concept of time consists of the origin's dedication to the outer world and of its withdrawal from it. Hence the concept of time is superior to all other concepts of the outer world. In this dedication to the outer world, the origin generates conceptual activities such as outgoing and withholding that bring about different external effects. Forces, resistances, sounds, light effects come into being. Time determines the arising and passing of external phenomena.

Grasping Time by the Perceptual Path

Interruption. Let us assume that an observer stands at the inside of a double door which can move slightly back and forth although it is locked. He is able to note that pressure is being exerted against the door from the outside, but he cannot see outside. If the pressure were always the same, the observer could describe it as an attribute of the door. He finds, however, that the pressure disappears. He now pays more attention because he expects the pressure to reappear, which indeed it does. The researcher describes his observations: The presence of pressure, its disappearance, and the appearance and presence of a lack of pressure. The phenomenon of disappearing/appearing he describes as *sudden change* or *interruption*. The phenomena are: pressure – interruption – lack of pressure – interruption, and so on. On further investigation the observer finds that the elements of this sequence are of very different character. Pressure (resistance) and lack of pressure (void) form a polarity. Where is the polar counterpart to the phenomenon of interruption? Has an element been overlooked?

Duration. Interruption would not be possible without something to interrupt. It belongs to the character of an interruption, that it disappears when it appears. It is therefore by necessity followed by something that can be interrupted. Two discontinuities are separate from each other by having something that can be discontinued between them. Pressure and lack of pressure are equally interruptable. — These considerations lead the observer to conclude that the capacity to be interrupted itself constitutes a phenomenon. He calls it *duration*. He may well have overlooked it so far because it forms a unity with the phenomena of pressure and lack of pressure.

Polarity. It dawns on the investigator that discontinuity and duration constitute a new polarity. He reasons as follows: Interruptions are a real external fact. They are the effect of an activity, that of interrupting. This activity is an entity, a living concept, that creates external unity when it extends into the outer world. In this way interrupting generates, at first, through the unity of its own activity, the opposite of what it wants to bring about, i.e. the capacity to be interrupted (duration). Only then is it able to let the external unity, such as pressure or lack of pressure, disappear.

How is it possible for interrupting to be able to remove pressure from the outer world? The pressure phenomenon is constantly produced by the outgoing action. In the moment when interrupting changes the outgoing action into its counterpart, withholding, the external pressure disappears. The investigator can now see in the appearance and disappearance of the pressure phenomenon not only the result of outgoing action and withholding, but he can see also the outcome of a higher form of activity that brings about the

changeover between outgoing action and withholding. He recognizes this higher form of activity in the interrupting and in its opposite, the creation of duration. Everything in the outer world proves to be interruptable unities, except the interruptions themselves. It is an interacting polarity.

Rhythmic Sequence. After pressure and lack of pressure have alternated several times the observer notes a reduction in, and finally an absence of the interruptions. He finds only a steady pressure. This condition changes again when the observer perceives, instead of the continuity, the previously described change in pressure with more frequent interruptions. It leads him to the following conclusions: Unities and interruptions alternate with each other. If the unity of the phenomena is dominant, all contrasts flow together into one nebulous unity. If interruptions are dominant, a confusing changeover results. Between these extremes, the investigator perceives the orderly alternations of interruptions and unities. Similar unities then alternate with interruptions. The researcher calls such regular interchange a *rhythm*. A unity which is bracketed by two interruptions he calls an *interval*. He is amazed to find that the intervals have a life of their own. Two intervals that are separated by an interruption can be united into one interval. The observer realizes, that pressure as well as lack of pressure are interruptable unities. As unities they tend to form a common unity together. Conversely, the interruptions tend to exploit the interruptibility of the unities. The resulting competition of the opposites leads in one case towards all-embracing oneness, and in the other towards complete fragmentation. The dynamic of the elongation and abbreviation of the intervals is to be found in between.

While the investigator is pondering these considerations, there is a visitor outside the double door; he is trying to open it by pushing against it and in this way causing the described phenomena. Let us identify ourselves with the visitor and study his inner life to the extent in that it is connected with the production of the pressure phenomena.

When the visitor creates pressure through his outgoing action, the origin of his activity makes him aware of the one-sidedness of his action. He feels the need to do the opposite, which is to withhold his outgoing action, and thus bring about a void, lack of pressure. He realizes that any external effect he brings about will have to be by necessity one-sided. The many-sidedness of his inner abilities causes him time and again to alter what he is doing and to seek a balance. — This inclination necessarily accompanies every act that is performed in the outer world. It is, therefore, intrinsic to external pressure that it has a beginning, a duration and an end.

The visitor outside the door begins to understand that he has so far overlooked a quality which forms part of all of his expressions. But if he tries to recover this in his external work, it eludes his cognition. When an external process begins, neither its duration nor its end exist in the outer world. Neither does the process exist externally when it ends. The visitor grasps now that he will never find duration and change as complete phenomena in the outer world, even if they do give shape to the external processes. Only if he takes into account his own participation in the external action, that is his expectation and memory, does the riddle begin to solve itself.

The Realm of Time

Past and Future. The first observer may now open the door and let the visitor enter. As the friends exchange their observations it becomes clear that the first of the two had witnessed the same event from a different perspective from that of his visitor. For the first observer the event *started* with the presence of the outer perception of pressure. He matched this to his conceptual life which he allowed to be shaped by the impressions, and he kept the impressed shape in his memory. As for the visitor, the event *ended* in the present with the pressure phenomenon he had brought about. He had intended to work outwards. His outgoing action became directed towards the door and produced the external pressure.

The friends call the first aspect of the event a *memory image* because it preserves and processes the outer impressions as an inner picture. The latter aspect of the event they call *an expectation image* because the abundant inner force forms its image all the more accurately the closer it comes to the outer world. Each investigator now understands the other's point of view. It is the same concept, that, emanating powerfully from its source, becomes external, allows itself to be shaped by what is external and returns again to its source. The source breathes out and in. Its rhythm becomes part of all the forms which it creates, both in the concepts arising from the origin, as well as in their effect on the outer world.

The Present. The observers have still failed to find the complete answer to their questions. Which is the realm of present, past and future? Can duration be measured? How can we meet each other in a shared present? They suspect

that all three questions are bound up with the insight into the origin of activities. The breathing in and out of the origin's force must always be living creative activity. Even if the origin's rhythm stretches out towards the outer world, it always will stay in the realm of activities, in the life of concepts. Time's realm is that part of the life of concepts that borders on the outer world. It is to be found where conceptual activities pass over into the outer world, where the life of concepts gives up part of itself, and where the stream of action reverses itself and becomes a counterstream flowing back to the inner world.

Our two friends call the whole process *time*. The course of time can only be kept track of in the life of concepts. A certain duration or time interval is externally visible, but cannot be externally viewed together. Hence the astonished friends have to admit that any external measurement of time must be incomplete. They wonder why two people meet one another in the same external present, even though they experience it constantly. They believe they can see the beginning of an answer when they look at the nature of their thinking. For this contains only *one* truth that they can both perceive and in which they can actively participate. *One* thinking runs through their insights, expresses itself in their work, and finally comes into contact with the outer world. The presence of thinking touches the external creatively through two people who meet each other in it.

Expectation Image and Memory Image. Shortly afterwards, our observers have the opportunity of seeing a rainbow. Both are familiar with the laws by which it comes about. The visitor, in particular, is able to predict a rainbow's appearance. He notes step by step how the position of the rain-

cloud, the sun's angle and other conditions meet the requirements that bring about a rainbow. The visitor expresses a few moments in advance his expectations regarding the size, position, intensity and timing of the phenomenon. The *expectation image* has taken on an exact content in both observers. — When the bow of color appears externally, the expectation image ends, replaced by the outer perception. During the short period the rainbow is visible, the host is able to observe the transition into its *memory image*. His conceptual life is freshly imprinted by the impressions made by the rainbow to an extent that literally colors it.

The friends are agreed that in the expectation and memory images they have before them the natural phenomenon's progression in time. This is all the more real the more exact both the outer and inner observations become. Both images belong to the life of concepts. One comes from the future and ends in the present. The other begins in the present and leads to the past. The observers begin to suspect that very little of time is to be found in the outer world. They may have hardly grasped the smallest part of time's essence. But they have begun to glimpse the wide expanse in which time streams from the inner to the outer world where it reverses in order to return to its origin, leaving behind footprints as interruptions and durations while still connecting both worlds.

Novalis' Concept of Time

Time is a dilemma for conventional physics which needs a unit of time for its basic laws. Physics denies the possible idea that the outer world is continually brought forth from an inner world to which it can also return. Therefore it postulates that time is nothing but an outer physical process. — In a century when physical thinking was still more flexible, Novalis worked at the basis of a future science which would include the inner world. He observed an inner space out of which external space is precipitated, and to which the latter can also return. As both spaces are in continuing interchange with each other, one is the complete counterpart of the other. Hence the inner space contains lines, planes and figures that correspond to those in external space in all three dimensions. Whatever manifests itself in the outer world as rigid, inert and schematic, is in the inner space alive, changeable and of a conceptual, creative nature. He called the inner space *time*. Despite the brevity of his description, Novalis' phenomenology of time is so precise that the only question that remains is whether it really exists. I should like to pursue this on the strength of further observations.

The Field of Rhythm

Interruption and duration are the polarities presented externally by time. One can contain all the outer world's appearances and the other none except of its own. Both need each other, complement each other, and interact. An interruption needs to be preceded and followed by a duration; duration, in turn, has a beginning and an end. Since the appearance of an interruption means also its disappearance, it needs to repeat itself. Both opposites unite to form the simplest phenomenon of time - the interval. They develop their own life leading towards enhancement. One interval is, by necessity, followed by the next; the flow of rhythm begins.

A simple or a more complicated drum beat presents itself as a continuous process, both in the drummer and in the listener. The perception of *drumming* is to be found as much in the pause as in the sound of the beat. In order to perceive this unity, the listener has to make himself become active. After a few beats, he gets hold of the rhythm in the memory image which then turns into the expectation image. The latter becomes a perceived external fact and returns, as memory image, into the inner world.

One could assume that a rhythm would just appear out of the future, touch the present and disappear into the past. If that were true, a rhythm would disintegrate at any moment into its past and future components. It is rather that the future rhythm seizes the past rhythm, and vice versa. Both melt into the experience of *the* rhythm, do not only touch the present but lift it into an area where past and future unite.

The Harmony Field

Time's sphere is further illuminated by the observation that every rhythm is subject to a restriction. Rhythm consists of the repetition of a certain interval of time. The latter may, for example, be subdivided into *short-short-long*. It is, nevertheless, a single basic sequence which continually repeats itself. The restriction is remedied if the first rhythm is joined by a second. The nature of a rhythm calls for the company of other rhythms. Two rhythms that are similar blend into one another and form a common rhythm as in a song for two voices. Other rhythms, e.g. in polyphonic music, are differentiated from one another but form a harmony, especially if one or more mediating rhythms join in. There then arises between the various rhythms a new element of time which we will call the *harmony field*.

The phenomenon of interference illustrates the concept of the harmony field. Let us consider two clocks that are ticking at two frequencies that deviate only slightly from one another; one clock ticks a little faster than the other. If both clocks can be heard together, a third rhythm arises due to the fact that the combined ticking of the clocks alternates between equal and unequal intervals. The third rhythm is much slower and forms a transition between both of the first rhythms without which it cannot appear. The phenomenon consists of three rhythms plus what happens between them. The continuity of the interference rhythm sheds light on the continuity of the first two rhythms. They flow continuously through future, present and past, and pulsate through the territory of time where both of them bring about the new rhythm. This area of time, the *harmony field*, unites the three rhythms and would be wide enough to accommodate other harmonizing rhythms.

The harmony field is more than an abstract summary of the various rhythms or their causal connection. A harmony field can be perceived to the same extent as each single rhythm. In so far as it reaches the outer world, it is a phenomenon like any other external object. Like other temporal processes, the harmony field extends beyond the outer world into the sphere of the conceptual, which is not abstract, but spiritually creative as it immerses itself in the outer world and disengages from it.

Just as every rhythm is a purely temporal structure, their interaction is also a process in time. The harmony of rhythms is a higher temporal phenomenon than each rhythm by itself.

In a single rhythm one interruption follows another whereas in a harmony the single interruption becomes unimportant. What matters is not the longer *or* shorter duration of the intervals but the common dynamic of shorter *and* longer intervals. The rhythmical sequence is intensified into a manifestation in which the essence of time comes to more perfect expression. We describe rhythms as the first, and harmonies as the second, dimensions of time.

Physiological Harmony Planes

One-dimensional temporal processes we find in the realm of plant growth. Algae cells are aligned next to one another. In the shoots of higher plants one leaf follows the other. Each plant offers its own simple rhythm to the great surrounding rhythms of nature. The bodily functions of animals and humans are based on the bringing together of rhythms. Heart beat and respiratory rhythms tend towards a four-to-one relationship. The rhythms of all the other organ functions are integrated into this central harmony. The rhythms of sleep, wakefulness and of digestion are oriented more towards the changes between day and night. Variations in the functions of the spleen, liver, kidneys, including the fluctuations of blood pressure act as mediators between the external and central rhythms. The harmony of these processes gives us an inkling of the human organism's temporal form. Each different rhythmical body function tries to be in unison with every other. In the ideal case it would be possible to integrate the interplay of all the bodily rhythms into the interaction between any two body rhythms. We call such a higher structure of the harmony field a *harmony plane*.

Clearly, a harmonious combination of rhythms can be disrupted in different ways. Technological influences or the consequences of a chaotic life style act destructively on a healthy balance. The same effect can be caused by the intrusion of a foreign rhythm that stands opposed to the harmonious balance of rhythms, e.g. as in cases of parasitical disease. If a foreign rhythm brings about a comprehensive picture of clinical illness, as in malaria, it is reasonable to suspect a combination of illness-producing rhythms, i.e. a harmony plane external to the harmony of the human body. A similar gap opens up between the rhythmical processes of different animal species which fight each other. Different harmony planes encounter one another, cross over and collide. Temporal events take place which are more than a harmonious combining of rhythms.

In simple rhythms the being of time brings about the alternation of interruption and duration without, however, overcoming their antithesis. In quicker rhythms interruptions prevail, while in the slower ones it is duration which dominates. In a harmony of rhythms the being of time shows its ability to generate various and different rhythms as well as to unite quick and slow rhythms into a more original activity. The contrast between discontinuance and continuance is overcome from its very origin. Although a synthesis of opposites is thus achieved, this outcome itself calls for an even higher manifestation of time. When time's origin is able to generate different rhythms and to unite them in harmony, it engages itself, in turn, with different rhythms. The origin is at the mercy of the one-sidedness of certain rhythmic combi-

nations. Even if it overcomes the one-sidedness, one or the other harmony comes about in every case. The enhancement of the opposites still bears traces of its external provenance. It never achieves a complete synthesis of opposites, but only different kinds of syntheses.

Hence, the harmony of rhythms cannot be the highest manifestation of time. One harmony may be incompatible with another. A dancing couple stops for a moment if the music changes, say, from three-four into four-four time. At this instant the couple has to adjust to the new music. Every dance is a harmony made up of various rhythms. During the pause, the dancer returns for a moment to his own ability to shape different harmonies and touches on the inner origin of harmonies. Whatever unites the different harmonies cannot be part of any external one-sidedness.

Time appears at the point of transition between the inner and outer worlds. It is the form in which inner actions reach the outer world and external effects are taken back into the inner life. The essence of this form is to be found at the origin of the outgoing activities, the origin that either engages with the outer world or withdraws from it. This whole process is a reflection of the phenomenon time in its different stages. Interruptions and their absence imprint themselves as fragments in the outer world. Rhythmical sequence widens through inner activity to become the stream of time. Within this stream harmonies of rhythms resound expressing the inner source of the activities. In between the different harmonies chasms of time open up which lead back to the spiritual foundation of all original activity.

Such time chasms have been repeatedly described and depicted as the focus of historical events. Widely different

historical streams converged in the era of discoveries when European sailors encountered the people of ancient cultures. — Centuries-old structures were shaken when individuals stood up for the truth under the most adverse conditions. Time chasms are also represented in the art of the tragedy where incompatible human lives converge demanding sacrifice and transformation. In the conflict everything that had developed in the life of those involved comes to a halt. The course of time stops and events take a different turn. This is often expressed in opera by means of musical themes which are not in harmony. The conflict has to be resolved in the listener's innermost experience.

Time gaps are time's third dimension which we call *the time field*. They contain the turns of event which lead into inner human experience. As the center of spiritual activity reveals itself in the time field, it is the highest and final dimension.

Is Time Measurable?

The drummer's rhythm, the harmony of a piece of music, and the chasms of events in the drama of human confrontation are outer as well as inner reality. In all dimensions time is also an external phenomenon. Everything external arises and vanishes through time. The perception of temporal processes necessarily leads the observer into that realm of activities out of which external phenomena arise and into which they disappear. Seen from an inner perspective these activities are living concepts which impinge directly on the outer world. Time is the inner space in which the activities take place as action and counteraction, structured in the rhythmi-

cal changes of intensity, in the harmonious interaction of the rhythms, and in the clash of incompatible systems of harmony. The totality of the events encompasses an inner space of activities just as differentiated as the external space which is constantly created, moved about and swallowed up again by the inner space.

The inner space, time itself, is not externally measurable. We measure the shadows it casts when it grasps spatial things and sets them in motion. Its spatial trace is measurable while time itself escapes.

SPACE : IDEA AND REALITY

A Cognitive Gap

More than any other phenomena, geometrical forms express clarity of thought. Their exactness and beauty challenge the observer's scientific thinking, the foundation of which they have been since antiquity. The Euclidian theory of space with its points, lines and planes is still part of the basics of school work. Conventional geometry, however, proves

Michelangelo, The Creation of Sun and Moon
Vatican, Sistine Chapel

to be a less stable pillar of the scientific edifice than one might expect. An infinitely expanded space eludes both our perceptive and intellectual abilities. Modern projective geometry has proven that infinity and dynamic thinking are close to one another. It gained access to a theory of space which leads beyond Euclidian concepts as its forms originate in the geometrical periphery, from where they are projected toward the measurable center. Einstein tried to cope with the theoretical problems of infinity by adding a fourth dimension to space. It is supposed to contain time and to make it possible for space, due to its "curvature", to be unlimited but not infinite. The idea of one or more additional spatial dimensions that include time was not new. It is in keeping with the need of the life of thought to create spaces that correspond to its own inner breadth and variety. The three Euclidian dimensions had become too narrow for modern mathematical and scientific thinking. In the attempt to widen and to differentiate space, however, the forming of the simplest geometrical concepts was forgotten. Points, lines and planes continued to be presented as spatial elements that do not require further explanation other than to be mutually defined. In this way the cognitive value of geometry had been weakened from the outset.

In this context a rather common interpretation of phoronomy (theory of motion) needs to be mentioned. It describes space, time and motion as purely mental depictions which can be recognized without a need to observe external phenomena. On the other hand, all the other elements of physics are supposed to be based on forces which our thinking can indeed put into conceptual order, although we can perceive their real content only externally. It is easier to discover the contradiction in this theory than to resolve it.

The transparence of the inner view of a geometrical concept does not relieve the researcher from the need to perceive the existing geometrical forms out there in nature. The fact remains that the distance of a mile in nature is more than a mental picture. If it is possible to perceive natural phenomena and to understand them with clear concepts, what is the principal difference between phoronomy and mechanics?

In recent textbooks phoronomy is hardly mentioned anymore; yet the cognitive gap is deeply ingrained in theoretical physics. We have on the one side the intellect of the scientist with his mathematics and his geometry; while on the other side we have natural phenomena which the intellect is able to put into order but not to create. How can we grasp nature by means of our insight? Einstein was aware of this conflict: "The very fact that the totality of our sense experiences is such that by means of thinking (operations with concepts, and the creation and use of definite functional relations between them, and the coordination of sense experiences to these concepts) it can be put in order, this fact is one which leaves us in awe, but which we shall never understand."

In his *Introductions to Goethe's Natural Scientific Writings* Rudolf Steiner showed the common foundation of all natural sciences: "Size, shape, form, position, movement, force, etc. are perceptions exactly in the same sense as light, color, tones, sensations of smell or taste, heat, cold, etc. Who separates the size of an object from its other properties, to consider it all by itself, does not deal any more with a real thing but with an abstraction of the intellect ... The spatial and numerical relationships have no advantage over the other sensory perceptions than their greater simplicity and easier comprehensibility." More than twenty years later, Rudolf

Steiner points out in his *Light Course* the gap between phoronomy and mechanics. It is impossible for the ordering intellect to build a bridge between its mental formulations and reality unless its thinking is made less superficial. Rudolf Steiner calls on physicists to rethink their basic mathematical and geometrical concepts. Habits of thinking need to be changed. It is not enough to operate with concepts while ignoring their origin. Only when the reality of thinking is taken into account in scientific research can the bridge to external reality be built. Rudolf Steiner did not only show the way out of science's general impasse, but he also described it step by step in the context of space cognition. In his exposition of Goethe's concept of space he proved that the three spatial dimensions go hand in hand with three basic steps in the formation of concepts. The whole wealth of our cognition is based on these three steps.

How We Experience Space

The different stages of our spatial awareness encompass more or less all our life experience. We reckon to live in space even though every night our consciousness withdraws from it completely, thus demonstrating that we are not just spatial beings. Something inside us begins to question about the nature of space when at times the *Aha* experience of geometrical proof gives us joy, or when we admire the harmony and beauty of crystal forms or ponder on the majesty of the starlit sky. Is space infinitely wide? If no straight line exists in reality, does it exist then in my imagination? The teacher can show a student how each drawn line becomes irregular and formless if looked at through a magnifying glass. The unity

of the line disintegrates in such a case into a collection of crumbs. Instead of pursuing geometry further in his imagination, the student might ask: What is spatial about a collection of crumbs?

One glance through the magnifying glass shows the student darker and lighter spots with blurry transitions and irregular edges. This time he pays attention to some other observable elements which up till now he had found uninteresting: What he sees through the magnifying glass with all the differences of light and dark is visible *together*. In spite of this, a dark spot is not where a light one is; light areas are not where the darker ones are. How can this strange structure be understood? The student is so impressed by the microscopic view of the drawn line that he forgets his geometrical constructions. His field of view includes something else besides light and dark. Where light and dark meet, the one ends and the other one begins. Hence the boundary between the two is neither light nor dark. Wherever the change takes place in gradually darkening shades of gray, close observation reveals a boundary which can shift. On one side of it, the shades become lighter, while on the other they become darker. Does the border itself have a medium shade of color? Can there be a color where there is no spatial extension? Am I adding with my mental process the borders to the outer reality?

The student finds these questions disturbing but also fascinating. He pays attention again to the dark spots which are visible together but lie separate from each other. One spot is not where the other is. If two such spots of the same color are close enough to one another they merge together into one single blob, since no color difference forms a boundary. Nevertheless, one part of the blob is not where the other is. If the

two merged parts were to move only slightly apart, just allowing a brighter rim to appear in between, both parts would again be separated by a visible boundary. A spot is not only dark but also separable. The student realizes that the property of being separable is just as much an external fact as the light or dark color. Separability, where no boundary can appear because the colors are the same. Separation, where the lighter and the darker shades contrast. Certainly, the student does not perceive an even line in this; but he does perceive externally the separation of light and dark just as much as light and dark by themselves.

In the field of touch perception the student makes a similar discovery. Even less than his eye, his touch gives him the impression of a complete geometrical form. There are impressions of resistance and lack of resistance which line up beside one other. Resistance and its absence appear together externally, with their separability and their separations. The student notes that separations always appear as the boundary of polar opposites, whereas separability is perceivable within the same quality, e.g. of a certain color or of a certain strength of resistance.

The Basic Concept of Space

The more our student devotes himself to his new observations, the more the usual geometrical exercises appear questionable to him: "Although I see why the sum of the angles in a triangle is 180 degrees, I do not understand what an angle and a line *are*. If a point is viewed as a contracted extension and a line and a plane as partly contracted and partly extended, does that reveal anything about what extension really is? How does a real extension differ from an imagined one? Can there be more than three spatial dimensions?" He cannot find an answer either in the Euclidian or in the projective geometry, as both use lines, points and planes as their basic geometric elements. He would like to know how points, lines and planes arise from thinking.

The student puts his complicated geometrical constructions aside and observes instead the simplest possible phenomenon. He chooses an impression of touch which he has while his eyes are closed. With one hand he touches the door frame while his other hand reaches into the door opening. He is aware of resistance and emptiness. On the one hand his outgoing activity prevails, on the other hand, his withholding. Both activities are familiar to him from his study of force and time. Up till now he had observed how one activity succeeded the other. Now he perceives how action and counteraction do not follow each other but reach outwards simultaneously. Prevailing outgoing activity encounters the resistance of the door frame, prevailing withholding encounters the void of the door opening. Each activity contains something of its counterpart. Are they blends of incompatible opposites, or are they true transitions? On his teacher's advice the student observes his experience of touch as thoroughly as possible. He sees the common ground of outgoing activity and withholding as well as their rivalry and interaction. But they remain opposite activities until they touch the outer world. The student does not find a true transition in the different degrees to which one or the other activity prevails.

A further suggestion from the teacher makes the student aware of an observation he had missed. Part of the door is the *boundary* of the door frame and the opening. What does

he do if he touches this boundary? The moment he puts his hand on the frame, his predominant retention changes into outgoing activity. Retention is taken back to its inner origin in order to give way to the opposite activity. As he senses the frame's resistance, his touch penetrates the force structure of the wood; at that very moment it crosses the boundary mentioned above. The moment he withdraws his outgoing activity from the wood frame, his touch is situated in the void of the door opening. Whenever he reaches out or holds back his activity, he finds himself on the one side or the other of the boundary without meeting the boundary itself. He no longer doubts: to meet the boundary itself he has to take action *and* counteraction from *both* sides back to their common origin. He notes a contradiction in this. How can he encounter the outer world if both activities are taken back? In that event, the origin's activity would remain internal and not be in the outer world. The student discovers to his astonishment, that what is impossible to logical intellect is a fact for thought that is alive. The outgoing activity and its withholding take place alongside one another; they mingle and struggle with each other. But whenever one activity wants to change into its counteractivity, it has to return to their common origin to be transformed. As a result, the continuity of the inner transition manifests itself externally as fragmentation.

Contemplation of the boundary amazes the student more and more. If the void ceases at the boundary and resistance begins, neither can be present on the actual boundary which means that nothing is there. Is it a nothingness that unites both opposites within itself as a seed? The student realizes now that he has found the true transition where he least expected it. Where it comes about, *both* activities withdraw to

their primordial stage, remote from the outer world. They leave behind externally the breaking off of both opposing phenomena. In our case it is the boundary between resistance and void. The student is convinced that he sees a fundamental phenomenon and calls it *outer separation*. The joint withdrawal of the opposing activities he calls *separating*.

The student understands more and more the extent to which the separating activity permeates his conceptual life. He finds it difficult to observe the new concept, since it belongs to the life of the origin where concepts themselves arise. But he learns now to distinguish features in an area of his thinking that he had hitherto experienced as a powerful, even if unstructured, source. The inner source's relationship to the outer world reveals a discrepancy. As soon as it tries to reach out towards the outer world, its activity becomes one-sided. It splits into an outgoing stream causing resistance, and a returning stream bringing about emptiness. Through each of the two streams the origin communicates its unity to the outer world. If the unity manifests itself as a stronger or weaker resistance externally, it has become fragile in consequence of having left the inner unity. The fracture lines are the external marks that the inner origin leaves behind when it again withdraws into itself. Its fragments are separated. Hence external unity has extension that the student calls *space*.

Space and Time

After the student has succeeded in grasping the polarity between separation and unity he notes its wide-ranging appearance spectrum. He would like to begin to review and order the new details. But a basic problem faces him. Do not his concepts of separation and external unity resemble those of interruption and duration? Are they perhaps identical? In both cases external contexts and their disruption are brought about, on both occasions the origin reaches out into the external world in outgoing and withholding action, disengages, and returns to its own self. In considering these things the student becomes aware of further contours in his conceptual life.

When the power of thought is engaged in the outer world, external things appear and disappear. When they appear, the boundary between the inner and outer world is overcome; when they disappear it is restored. It is out of the creative rhythm of living thought that time is created. Only secondarily, thought considers what has been created externally, and so discovers that it is able to have an overview of contrasts and to unite them. The boundary between the inner and outer worlds becomes the subject of inner observation; it becomes conceptualized. Thus thinking is now able to cross this primeval boundary not only in one or the other direction but simultaneously in both directions. The primeval boundary between the inner and outer worlds, transformed by means of concept formation, is cast out into the outer world and becomes a boundary between external things. External space arises out of the creative rhythm of thought as it is reflected in inner overview.

The student is eager to establish as clearly as possible the difference between a boundary in space and an interruption in time. For it is on this that his further insight into the nature of the outer world depends. His consideration of the source of active thinking, he believes, has led him to the threshold of a new view of time and space. The feeling of having come closer to an understanding of the creativity of nature fills him with joy, but also with unease. For it is only in brief and hard-won moments that the living source of thought reveals itself. He notices changes in his own emotional life since his involvement with the new insights. The student decides to ask the teacher, to whom he owes his new direction of thought, for advice.

Student: My research in the fundamentals of natural science has brought about an unexpected change in my life. The new thoughts are difficult to grasp. When I do succeed in viewing them, they give me a feeling of joy and inner enrichment which constantly attracts me.

Teacher: Have you other obligations?

Student: I have neglected my professional training recently. I have also become less sociable.

Teacher: You have gained insight into a way of thinking that is more powerful than the usual thinking. It will take years of hard work before you will have made relatively little progress. You should therefore take care not to neglect any of your professional and social obligations.

Student: I promise to do that. How can I strengthen the new thinking within me?

Teacher: The inner eye for the reality of thought wanes if it is not opened at least once a day. As we are most strongly connected with our living thinking when we sleep deeply, it

is best to bring it into consciousness in the early morning. For this a meditation helps, which you can build up piece by piece over days and weeks. You can bring its content before you each morning in the following way:

The mineral kingdom
Teaches me about the beginning of creation;
The plant kingdom with all that lives
Reveals the beauty of the creative spirit;
In joy and suffering of the animals
Lives the power of spiritual existence;
The thinking of human beings
Opens the inner world.

It is best to carry out this, or a similar, contemplation only in imagery and feelings, without words. Then follows the more difficult part of the meditation:

When I wake up in the morning and open my eyes, I perceive a world which presents itself to me without my contributing to it. The insight "What is there is *outside* myself" is a truth based on itself, with an inner unity, in which I actively participate. The truth unfolds a life of its own when I meet the external with insight by means of outgoing action, or when I allow the external to work upon me, withholding my own action. The common origin of outgoing and holding-back activities, in its pendulum beat creates time. From the overview of the origin's activity, space is created.

Separations. Temporal interruptions delineate the border between outer and inner worlds. Spatial boundaries separate external entities. Due to the nature of their basic elements, time and space belong to different regions of existence, their interactions remaining incomprehensible so long as they are mixed up together.

The basic elements of space are separations which are manifest externally. A separation consists of the demarcation from each other of contrasts such as light and dark, resistance and emptiness, when both are present. (Figure 1). The observer comes to understand a separation when he examines the activities, which have brought about the separate external opposites, in their withdrawal into their common inner origin. In the insightful active encounter, separation can be realized.

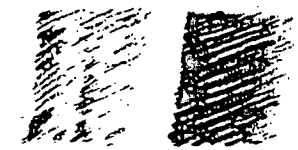


Figure 1

Separation and Unity. Since the nature of an external separation lies in the withdrawal of unifying thinking from the outer world, outer unity is the polar opposite of the external separation. Every external wholeness demands that it be broken up. Every separation would like to disappear and give place to unity. Separating and unifying are rival aspects of the same concept. Through this extended concept the observer comes to grasp a new experiential element. He recognizes in light and darkness, resistance and void, not only

different external effects, but their common external unity, i.e. their separability.

Distances and Extension. Since two separations as such cannot externally connect anything, they stay away from each other (Figure 2). By their very nature they surround themselves by what they are not, i.e. external wholeness. Once separations are understood, they manifest themselves as distances. Both aspects of the separating activity are apparent: Separations and their external connection. The distance between two separations is a polarity of the simplest kind consisting of the separations together with what they have externally in common. This latter is separable. We call this external wholeness *extension*. The observer is not just confronted by a world of distinct impressions. Between the boundaries can be perceived what all the different available shades of color, quality of touch, etc. have in common: Extension. Boundaries enclose that which they themselves are not. Space extends in its polarity.

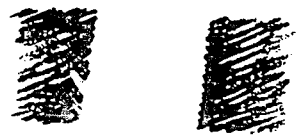


Figure 2

The Dynamics of the First Dimension. Our thinking masters space by unifying it as it proceeds from separation to separation. Each step creates a new distance. Separating and unifying are thus in continuous interchange. The more separating prevails, the more extension will be fragmented. The more unifying prevails, all the more are separations removed. The fragmented units dissolve into one common,

large extension. This latter is separable and contains the potentiality for many *small* pieces of extension.

The tendency to become greater or smaller lies in the nature of the distance formation. It encompasses its inner conceptual side: The expansion of the activity of unifying, and the concentration of withdrawing to the thought origin, the latter process becoming visible in the external separation. In space greater distances spread out alongside smaller ones. The inner movement of expansion and concentration pulsates in the cognitive life. We call these inner and outer dynamics of distance formation the first spatial dimension. This consists of perceived boundaries, separable extensions, and of both shorter and longer distances, but not yet of points, lines and planes.

Can an extension that embraces one separation after another become infinitely great? It cannot do so as long as the space described here remains externally perceptible. If, however, we were to let our gaze travel as far as the farthest, perceptible border and were to take into account the existence of another spatial entity beyond this border, the realm of the perceptible would touch the region of the imagination where infinity is at home. The same happens in the opposite direction with the process of diminution.

The Second Dimension

Its Concept. Once the observer has grasped the dual concept of separating and unifying, he sees how they are two sides of one life of thought that can either turn towards, or withdraw from the outer world. Understanding what is common in the life of thought within different concepts, is an

inner step which may be described as the *comprehension of concepts*. It makes it possible to grasp the second spatial dimension with its web of separations and combinations. Our concern is not only with a bit-by-bit extension or diminution of a distance. Every distance now shows a tendency on the whole to become both greater *and* smaller. If this tendency triumphs, the result is a line which is the combination of all the distances that belong to the extension and diminution of the original distance. What matters now is the *connection of distances* instead of the connection of separations that we had in the first dimension.

Figure 3

The dynamics of extension and diminution, going from separation to separation, gives rise to band-shaped figures (Figure 3). The incompleteness of these figures becomes obvious if their concept is made specific. When separations are lined up, to be exact, distance is added to distance, smaller distances are supplementing one another to become one greater one. It is an interconnection of distances within *one* single, common distance. This turns out to be a special case among all the possible distance combinations, for it is also possible for two distances to be located next to one another in such a way that they are *not* part of one common distance (Figure 4). If each of these two distances is formed by two separations, each separation by its nature stays away from *every* other. The result is lines which are separate from one another (Figure 5).

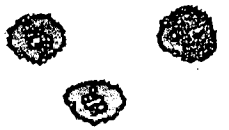


Figure 4

Figure 5

As far as lines are comprehended, they are recognized in the outer world. A country's borders, for instance, are not only imagined but also for real. They may consist of stone markers, grass, etc. The linear separation is just as real as the countries it separates. A line's reality is attained in the cognition of what is externally perceived.

The Line as Extended Separation. Two lines which lie apart from one another, each behave in their totality like separations. They form a distance to which a similar distance can be added. The extension between the two separating lines can be divided by a new separating line. Experience shows that such relationships of distances and lines really do exist. Each line holds, according to its own extension, the dynamic of increase or decrease in its contained distances. But as a separation, a line becomes part of a further new extension going beyond itself. If two lines move closer to each other throughout their length, the new extension lying between them decreases to become a narrow band which diminishes further on the way to becoming one single line

(Figure 6). Only at this stage does the single line reveal itself to be the result both of its own extension and, simultaneously, of the disappearance of the new extension stretching beyond the original line.

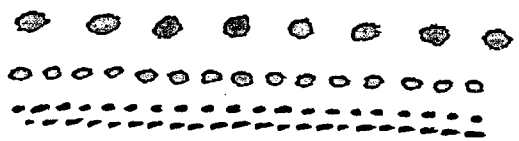


Figure 6

Extended Extension. If the investigation went no further than the lines which, in their entirety, lie at longer or shorter distances from one another, no real progress could be achieved. The sum of these lines would be a mere repetition of the dynamics of the first dimension. Progress towards a truly two-dimensional phenomenon can only begin where a connection is set up between the dynamics within a single line and the common dynamics of the lines lying apart from each other. Such a connection derives from the absolute predominance of the separating process. The distances, which are made up by the whole lines decrease to become the narrowest band possible while, at the same time, distances along the single line's length shrink right up to the last separation which we call a *two-dimensional point*.

Such a point's reality is brought about by separations that have moved extremely close to one another in two ways, both as whole lines and within one single line. What has thus contracted can also expand again in the same way. We have now literally found a starting point for cognition that provides greater clarity about the expansion process. A new extension becomes apparent which takes out only one point

from each line. Lines, which up till now were separated from each other, are now connected by the new line (Figure 7). Each of the first lines had an extension limited to itself. The new line, however, springs from one of the original lines to the other and takes possession of the extension which goes beyond each of the first lines. Its extension is of a different kind, having, as we now can say, *a different direction*.

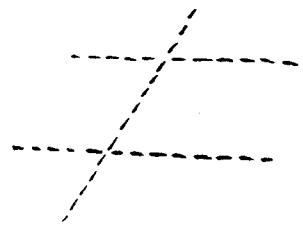


Figure 7

The Concept of the Field of Lines. A single line's extension can be recognized on the simplest spatial level. Comprehension starts with the unknown, the separations. It unites them into distances, i.e. the polarities of separation and extension. When several lines are extended, this simple cognitive approach does not suffice. Comprehension has to take one further step in order to grasp the line as a unity from the very beginning. Instead of concerning itself only with lining up separations, cognition looks back on itself as well. It discovers its own activity, i.e. thinking, with its ability both to divide *and* to connect. This constitutes the dual tendency of a distance to increase as well as to decrease itself, and brings about a spatial entity which is both separation and connection in one, i.e. the line.

The new ability produces not only different lines but also what is common to them all. It is a second level of comprehension and cognition in which conceptual life understands

itself. Only such a deepened cognitive approach can provide an insight into the interrelationship between two lines. Such an approach shows how, in Figure 7, due to the connecting line, a new element is provided: the field of lines.

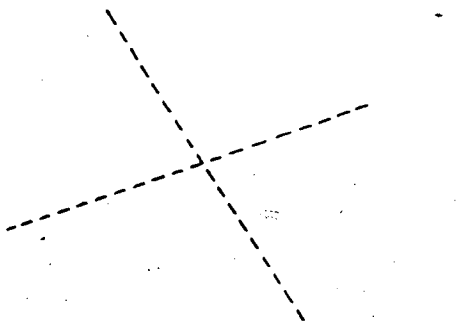


Figure 8

... its Appearance. What lines have in common is not only conceivable but can be externally perceived. Where two lines lie adjacent to each other, the space between them expands. It is composed of the external absence of lines, of a unity that is separable by lines. All possible lines could appear in this unity. We call this phenomenon *a field of lines.*

The basic phenomenon of the field of lines is two lines with a common point, i.e. which cross each other (Figure 8). The two lines form four interstices which extend to their common periphery. It is here that it becomes apparent how the interaction of the lines is linked into the same polarity from which the single line also originates: separation and extension. From absolute separation, the four line branches reach out into total extension. From there inwards, the four interstices meet with their four tips at the center point.

Field Separation

In forming the common point, two lines behave as separations whereby extension is given up. Two lines as wholes also react as separations if distances within each line are ignored. Then only the distance, which the two lines form as separations, matters. Essentially, such a linear field depicts the shorter or greater distance of whole lines. We call it the *separation field.* The corresponding geometrical process we call *field separation.*

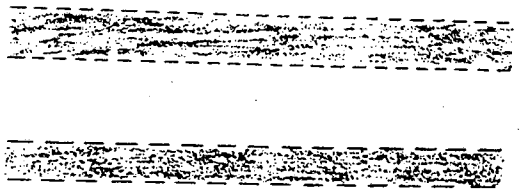


Figure 9

By its nature, a separation field forms a series of typical shapes. It appears, e.g. as a set of parallel lines (Figure 9). From the standpoint of the separation field, parallels are described as lines whose common point has moved far away. - The process of field separation is also apparent when the intersection of the lines becomes visible. Then all the lines run through one single point; because *field separation only divides the interstices without connecting up the lines to one another.*

... forms Angles. In the case of parallel lines, it might seem as if the formation of different distances between whole lines could be a repetition of distance formation between simple separations. As soon as the intersection of two lines is also taken into account, the true linear dynamics of the separation field become apparent (Figure 10). What is involved is the

enlargement and reduction of *angles*. Whole lines move closer to one another, as one pair of angles decreases. At the same time, the arms of the neighboring pair of angles move away from each other. The process ends in the merging of both lines in one common direction. Should the directions of the two lines increasingly diverge, an intermediate position arises in which the adjacent angles become equal *right angles*.

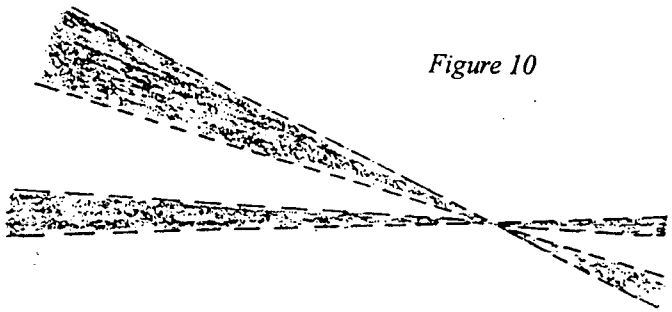


Figure 10

... and Circles. Here a spatial process takes shape that returns into itself. Both sides of the polarity, expansion and diminution, proceed in mutuality. This belongs to the nature of the second dimension. It is the external manifestation of the origin of thought that creates the primeval polarity of space. Separation and extension are the result of different conceptual approaches springing from the same source. When this source creates space, the polar opposites appear in dynamic interconnection. The enlargement of one angle implies a reduction in the adjacent angle.

We arrived at the interconnection of greater and smaller angles by considering the separating nature of the lines. The result is a spatial figure brought about by the predominance of the separation process (Figure 11). All lines come together in the common center. The combination of larger and smaller

angles is not yet an outer rotation but, conceptually, the rotating movement is already present. The inner center point of the cognitive rotating movement is thinking. The interchange between the opposites is continuously kept in balance by the common origin. From the spatial center, these rotation figures strive outwards to the periphery tending to complete circles.

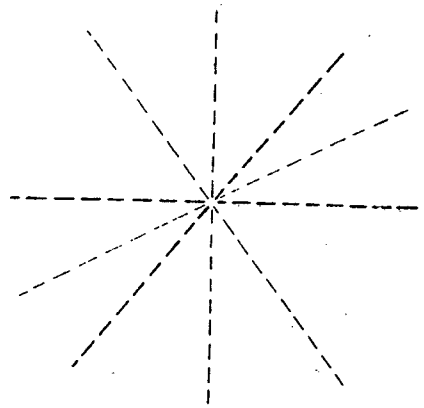


Figure 11

Field Extension

How, in contrast, would a dynamics derived from the extending nature of a line become manifest? Let us return to the simplest figure formed by the mutuality of lines: two intersecting lines. We now perceive the lines not so much as separating but as connecting elements. In forming angles, the concern was to divide the interstices of the lines without forming any connections. From this it is already apparent that the size of, and changes in the angles are not important for our present consideration. We pay more attention to everything achieved by lines through their extension, to how they bridge distances and interconnect with other lines.

... ***its Linear Dynamics.*** A third line which connects the first two does not go through their intersection. It makes its own intersections with each of the first lines. But what is new, is not so much the formation of additional intersections, as the bridging between the two arms of intersecting lines. The figure is no longer centered in one point. Distances come into mutual relationships. This may be represented by two hikers, each pursuing his own route and direction from a common starting point. For a while they are able to see and wave to each other. Our third line, on which the hikers wave to each other, has its own rules. As its position is determined from point to point by the proportions of the *distances*, we call the space traversed by the third line the *extension field*, and the corresponding dynamics of the lines the *field extension*. The latter becomes visible when all possible combinations of the hikers' positions are taken into account. When they move at the same speed, the connecting line assumes a middle position. The faster one man goes, and the slower his rival, the closer the connecting line approaches the direction of the faster. The geometrical relationship would then approximate to the case where one traveler moves extremely fast while his friend stays glued to the spot. It can easily be seen how the totality of the regular variations in relative positions circumscribe a hollow shape. In the case described above, it is a hyperbola. The connecting line approaches more closely the one or the other route alternately without, however, completely taking on either's direction (Figure 12).

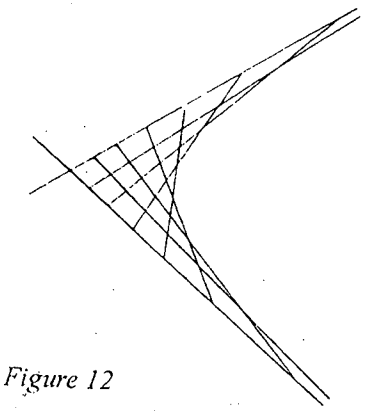


Figure 12

... ***and Concavities.*** The curve of the hyperbola swings out into the periphery and from there stretches back into the small, visible realm. It touches neither of the two separating lines and stays well away from their central intersection. It is entirely the result of the dynamics of the extension between these two lines.

In similar ways, even if in a less pure form, the astroid (hypocycloid, Figure 13), too, follows the laws of field extension. It forms concavities at its outer edges. Since all the connecting lines divide the axes of the linear cross rigidly into identical distances, the figure cannot connect with the periphery. It has to cling to its center point and becomes partially involved in the dynamics of rotation which derive, in effect, from field separation.

Between the circle as an expression of field separation and the hyperbola as a result of the field extension, there exists a wide variety of shapes. They are partly transitions and partly just sectors of linear webs which show their characteristics only within a wider context. Let us recall that in every case a linear extension is the result of a spatial connection going from

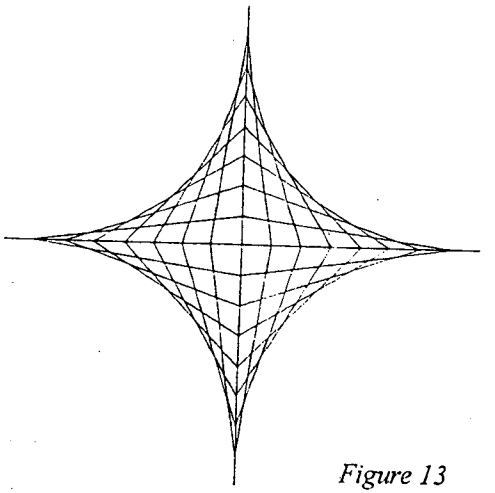


Figure 13

one separation to the next. The very nature of a line is to be found in the dynamics of becoming larger or smaller, oriented towards two separations. A line is, therefore, by its nature *straight*. The curvature of a circle or a hyperbola only arises out of the interrelationship of lines pointing in different directions.

Rotation and Turn. It is possible, within an angle, for a third line to come closer to one or other of the two arms. If this happens as field separation, the third line becomes a separation between the two arms by passing through their intersection (Figure 14). Their transitions form angles of different sizes; *rotation* comes about as the basis of the circular shapes. Should the third line come close to either arm of the angle in the sense of field extension, it connects both lines and avoids their intersection (Figure 15). Its change of directions then moves in the opposite way to that of the rotation; hence we call it a *turn*. Turns circumscribe concavities.

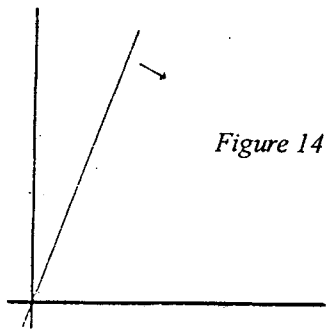


Figure 14

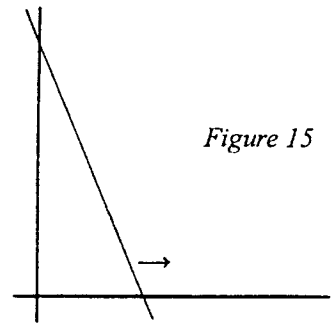


Figure 15

Just as the concepts of rotation and turn are opposites, so, too, are their natural manifestations contrasting. Circular forms are to be found where what is solid prevails. On the sea shore the pebbles retain their rounded shape. Where

water prevails and erodes the ground, it forms concavities. In plant growth we find rotation in the movement of the shoots; we find turns in the fluttering fall of a leaf. Here already, the polarity between the life forces striving outwards to the periphery and those shining in from the cosmos, becomes visible.

The Third Dimension

If the field of lines reflects the thinking that brings forth and unifies the concepts of the linear figures, why is it not the ultimate and supreme spatial unity? Experience shows that fields of lines themselves must first be connected into spatial unity. A field of lines resembles a single line in that it is both extension and separation in one, even though its extension is more complex. Is it possible to pile one dimension upon another indefinitely? Since we consider space to be a creation of living thinking, we seek to solve geometry's riddles by means of thinking itself. The three-dimensional forms, we encounter, point towards an even higher form of concepts than was the case in the field of lines.

The origin of the conceptual life that forms lines creates its spatial expression in the field of lines. It is out of the latter that the lines spring up in their different directions and positions. The field of lines is, however, not yet a unity, since the linear combinations come about through the ability of the lines either to separate or to unite. The field of lines consists of both extension and separation fields and of their combinations, but is itself not yet a complete spatial unity. The contrast between separation and extension is only partially overcome.

Outwardly Conscious and Self-conscious Thinking. A further, new cognitive step is needed. In the forming of distances, our concepts of separation and extension have taken account of external perceptions and have recognized their polarity. In the formation of linear figures, the common origin of the concepts was at work. The thought element that was able to produce the concepts *together* of separation and extension, now comprehends shapes which are both separation *and* extension with all the manifold variety of their interactions.

Concepts are thought patterns which are turned towards external perceptions. The thinking, which forms concepts about the outer world, is itself also outwardly oriented. The source of concepts directs its activity away from its own content. It is only when thinking focusses its attention on itself, that it has the highest form of existence as its content. New insights reveal themselves if this difference in thought life is considered. It is a different kind of thinking that forms concepts about outer objects, from that which looks into itself. The first we call *outwardly-turned* or *outwardly-conscious thinking*, and the latter, turned in on itself, we call *self-conscious thinking*.

The outwardly-turned thinking forms the concepts of polarity in the first dimension. It enhances the dual concepts towards the interactions of the second dimension with its spectrum of shapes. The enhancing thinking, however, is still occupied in leading the multiplicity of outer separations into the unity of the extension. It moves either from multiplicity towards unity, or vice versa. In both cases it still contains something of the quality of separation. Thinking has not yet

arrived back at itself. This is why the second dimension cannot attain a complete unity.

The Concept of the Plane. The forms of the separation field flow from a point towards the periphery. The points, and the separating quality of the lines, give the whole field its character of separation. The separation field as a whole can separate. Two separation fields can stand apart from one other, just like two simple separations. - The extension field flows from the periphery to a point. It receives separating character from its lines and their intersections, just as the separation field does. We have in the separation field, as well as in the extension field, a linear interrelationship which can separate off as a whole entity. Every such interconnection proceeds from one line to the next. We call it a *plane*. A plane's nature lies in a dynamic of rotating and turning, that is oriented towards two intersecting lines. Hence by its nature a plane is not curved. Curved surfaces are the result of an interrelationship of planes (Figures 23 and 24).

Planes and surfaces are the stage on which the contrasts between separation and extension are reconciled. The tranquil surface of a lake is constantly traversed by concentric circles; every movement is conveyed by lines to the periphery. The rhythmical flow back and forth between center and periphery is the particular characteristic of the second dimension. It may be confined to a line or even be expanded into a sphere.

Cognition of the Third Dimension. The third dimension is encountered whenever the separating nature of planes is overcome. This can only take place on a level that is higher than that, where the swinging back and forth between sepa-

ration and extension occurs. What is swinging back and forth, and who turns towards the outer world?

The selfhood of thinking is an inner unity. It works outwards, yet without losing itself. What emanates from it receives of its unity. Inward-directed thinking is a spiritual reality. The third dimension is part of the outer world; in order to create it, thinking has to work outwards beyond itself, it has to move away from its own center, losing thereby the capacity for final unification. Is there a contradiction?

In any plane its origin is externally apparent. All planes have their origin in common. While the interaction of distances leads towards the overcoming of polarities, in the interaction of the planes we find only the common ground of similarity. When I am faced with a plane, I begin to create it. Here thinking observation expands the realm of experience: In beginning to create it I meet in the outer world the common medium of the origin of planes; I recognize the third dimension. The outer world contains the potentiality of all the different planes there might be.

Planes have a dual aspect in appearance: They are the theatre for the interaction of distances, thus illustrating the enhancement of polarities to a higher unity. Planes are not themselves the highest form of unity but a bridge that leads opposites towards unity. Beyond this, planes radiate higher unity towards one another. "Here is higher unity — there is the same higher unity." The light of the higher unities is reflected from the different planes, and it melts into the final spatial unity that shapes everything.

Double Rotation. The variety of three-dimensional forms which we call space leads to new interrelationships. If in a row of parallel radiator panels I am only interested in the distance between one panel and the next, this remains a one-dimensional process. But if I consider the rotation of a plane around a line, such as the movement of a door, a two-dimensional process is involved. What takes place is, in principle, the same as the rotation of a line around a point.

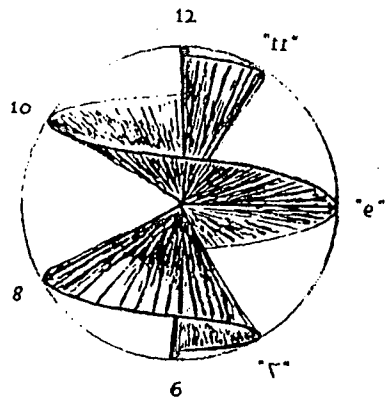


Figure 16

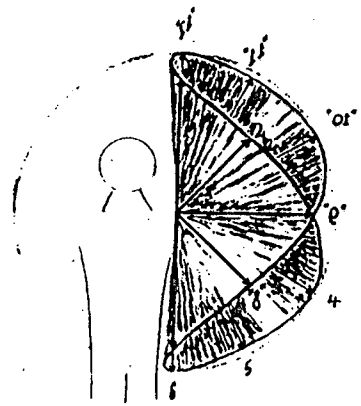


Figure 17

A three-dimensional event comes about when *all* directions are included in the rotation. In order to produce it, let us dangle a watch with a second hand from a thread, allowing it to rotate around its own vertical diameter. Now observe the movement of the second hand in space. If the hand stands still pointing in different directions, it circumscribes corresponding cones. If it moves, it forms in- and outgoing spirals in all transitions in-between these cones (Figure 16). A special transition takes place when the hand is positioned vertically on the dial's axis of rotation. Instead of a cone, it then circumscribes a plane that is vertical to all possible positions of the dial.

If the watch hand and the dial rotate at the same speed, a swinging form results, which can easily be demonstrated by describing a vertical figure of eight with an outstretched arm. The arm then represents the movement of the watch hand on an imagined dial rotating in the way described (Figure 17). We can imitate such a composed form with our movements more easily than a simple rotation, for example.

The lemniscatic arm movement described above is the combination of two rotations. Instead of the unifying oscillation between separation and extension, as it takes place in the simple rotation, we are dealing here with unity itself. The context of two rotations shows the reflection of the unifying process within itself.

The Unity of Field Separation and Field Extension

The interaction of planes leads invariably beyond the dynamics of the first and second dimensions. Let us consider two entirely separate planes (*I* and *II*) which can move closer to or farther away from each other. If these planes do not intersect, they lie parallel to each other. Within the greater or smaller distances between these planes, a third, so far unknown, linear extension reaching beyond the twofold linear extension of each plane becomes apparent. We choose from this new extension a line *a* which we assume not to be inclined towards either of the two planes, and which therefore lies vertical to them.

This line *a* forms a new plane with each main direction of the original planes (Figure 18). The resulting intersection of three planes located at right angles to one another is a basic form of the third dimension, since it combines the three

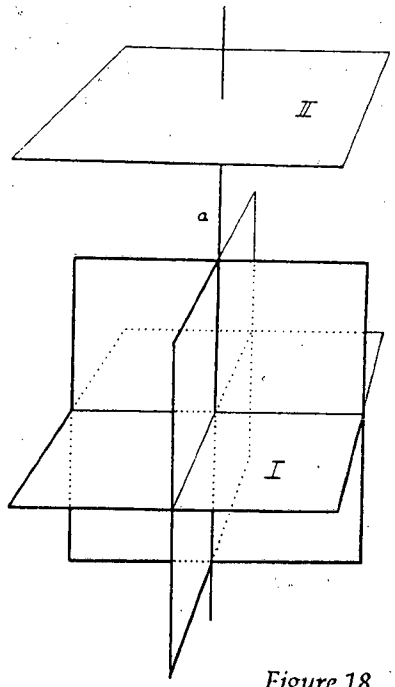


Figure 18

main directions in the simplest way. A preliminary consideration of this intersection of planes already reveals some of the language of three-dimensional forms.

The interaction of two planes which stand at right angles to each other resembles a simple linear cross. The transition from one plane to the other can be achieved by rotating them about their intersecting line. The two planes then relate to one another according to the rules of field separation. The third vertical plane relates differently. It bridges the angle between the first two planes thus depicting the process of field extension.

Each plane forms a dual interrelationship of field separation and field extension with the others. The intersection of the three planes shows in the simplest form how field separation and field extension unite in the third dimension. The interplay of the planes produces new forms in which rotation leads by necessity to turning, and vice versa. This will be illustrated in further examples.

Spatial Dynamics arising from Field Separation. Rotation and turn, as described on page 68, give us insight into the fabric of the second dimension. Is it possible to obtain in similar ways an understanding of the dynamic of the third dimension? Rotation with its circular forms results from the transition between two main (vertical) directions by means of field separation. The transitioning third line approaches alternatingly the two main directions without connecting them. Therefore it has to go through the common intersection (Figure 14).

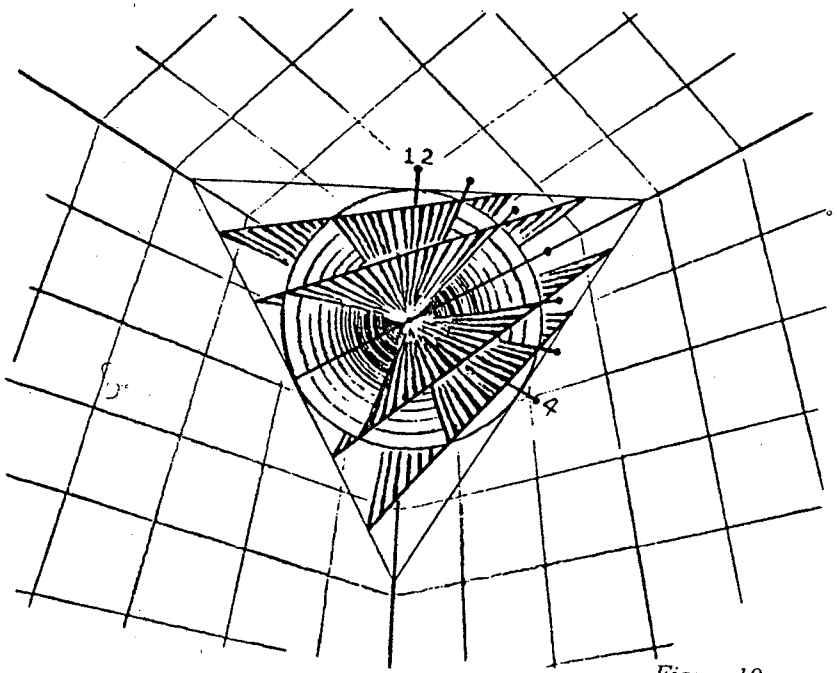


Figure 19

Can this dynamic be transferred to the third dimension? There we find three vertical planes instead of two vertical lines. A fourth plane, therefore, will have to approach in

steady transition alternatingly each of the three main planes, going through their intersections.

Such a situation would come about when, for instance, the right wall of a room approaches in steady transition the ceiling and from there the left wall. In doing so, the wandering wall hinges in the upper corner of the room. Figure 19 shows quickly that the wandering plane connects all other planes although we follow the principle of field separation. The experienced geometrist realizes that the rotation of this figure in its cross section not only forms a circle but also an astroid (Figure 20). These particular forms, related to the "epicycles" of Ptolemaic astronomy, arise by means of double rotation, in our case simultaneously clockwise and counterclockwise.

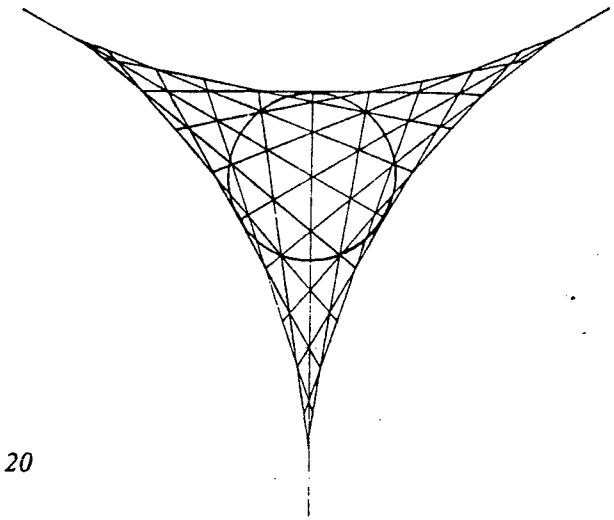


Figure 20

This rotation of planes shapes in its totality a three-sided pyramid from within, its sides being curved inwardly as if caused by suction; a form more organic than mineral in character (Figure 21).

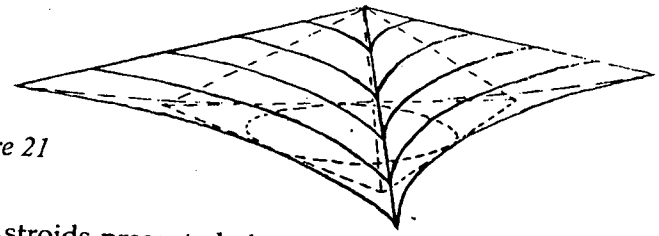


Figure 21

Astroids presented already before as forms of both rotation and turn in one (Figures 13-15). Here it is the common ground of the rotations and their transition into the turning process that is basic to the formation of three-dimensional space. Is it a contradiction that this process also can take place on one plane? Every three-dimensional rotation and turn can be projected onto a plane. Our eye, however, tends to perceive bodily shapes in such forms even if they do appear only on one plane. A transition between two main directions on one plane requires either a rotation or a turn. A continuous transition between the three main directions of planes in space creates of necessity the mutuality of rotation *and* turn.

Spatial Dynamics arising from Field Extension. We are looking for a three-dimensional dynamics that arises from the field extension. What is involved is the common extension of the three main planes from their point of intersection. This common extension comes to expression in a fourth plane which connects the lines of all three main planes with one another. In the simplest case the fourth plane forms an equilateral triangle. From its intermediate position this plane has to approach the three main planes' different positions without going through their intersections. Thus the fourth plane accomplishes spatially with the three planes what the

third line had done with the two intersecting lines in the turning process within one plane (Figure 15).

Here it becomes obvious how in the third dimension a turn is quickly joined by rotation. For if the fourth plane turns sequentially in the way described towards the main planes *I*, *II* and *III*, it has, from necessity, to rotate around a central axis (Figure 22). Let the three main planes be represented by a rigid container standing on the intersecting point of the three planes, with its central axis perpendicular to the table beneath. Let this be the starting position of the three main planes. If we now pour water into the container until it is about a quarter full, the water level forms an equilateral triangle which we recognize to be the *fourth* plane.

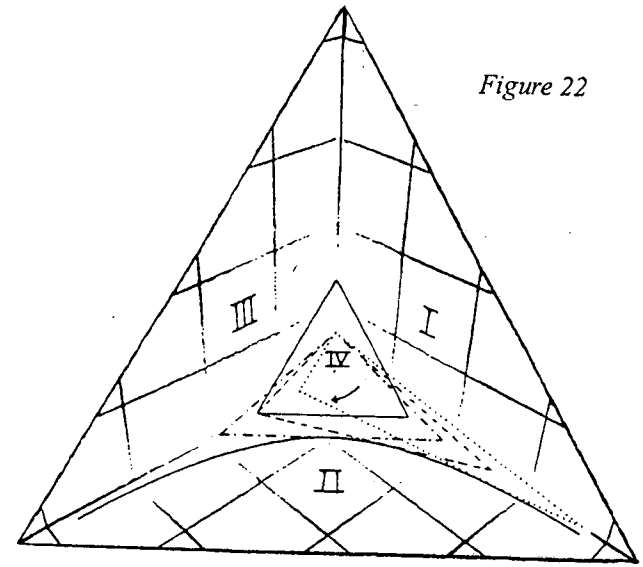


Figure 22

When the container is tipped towards the side of plane *I*, the latter approaches a horizontal position as well as the surface of the water. Will the container be tipped towards the

sides of plane *II* and *III, without going back to the starting position,* these planes will also approach one after the other the position of the water surface. The central axis, without itself rotating, thus will circumscribe a cone whose vertex is the lowest point of the container.

Let us follow the movement of the rim of the water on the container's sides. In order to picture it better we add some ink. When the container's edge lies almost horizontal the water triangle is totally elongated. From there it spreads over the plane of one side in order to spread further from there to the next edge. The water rim thus describes a turning curve on each of the main planes from one edge to the next (Figure 22).

We began with the "fourth plane" which expresses the unity of the extension of the three main planes. Its dynamics become visible when we shift the middle position of the fourth plane out of balance, moving it evenly towards all sides. We turn our container slightly at first, then more and more. This causes the water surface to form numerous triangles that describe in combination a concave form. The fourth plane rotates and turns at the same time.

Spiral Rotation. The unity of the circular form and the concave form becomes apparent in a special way in the three-dimensional shape of the spiral. Its construction calls for the consideration of several geometrical details.

Spiral rotation results from the transition between lines which lie in different planes and do not intersect. For each pair of such lines a connecting line, at right angles to each line, can be found. This is the axis of the spiral rotation (Figure 23). Line *a* merges into line *b* by rotating around the axis *AB* while moving along it at the same time. It is a spiral

rotation, similar to the twists of a drill (Figure 24). Such a form results from the interrelationship of planes, for every radius of rotation lies in a different plane, similar to the situation encountered in the case of lines *a* and *b*.

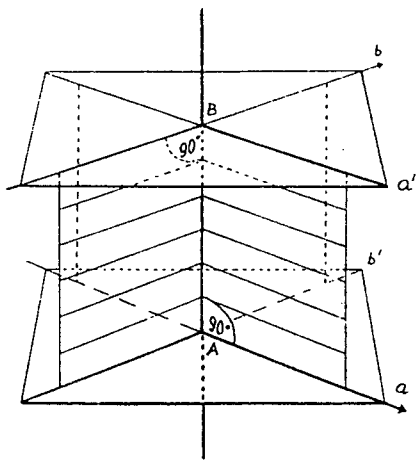


Figure 23

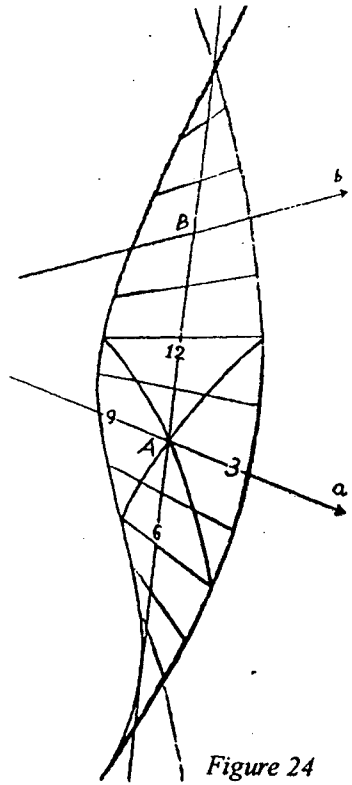


Figure 24

Spiral Turns. Let us examine the concavity of a spiral. For this purpose we acquire a piece of wide longitudinally ribbed elastic. Before we twist it into a spiral, we mark a sequence of parallel cross lines on both sides of this ribbon at right angles to the ribs. In addition we mark the rib in the middle as the spiral axis.

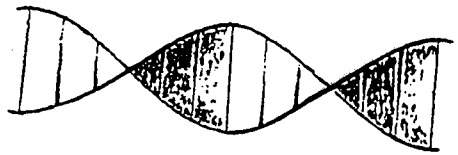


Figure 25

In order to view the different optical projections of this shape, we have to limit ourselves to observation with one eye: If we hold the spiral at right angles to our line of vision, the spiral appears viewed from the side as a sinusoidal shape (Figure 25). If we then hold the spiral along our line of vision, it appears as a circle.

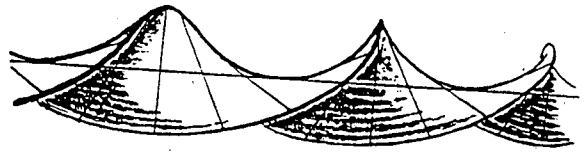


Figure 26

In the transition from the first to the second position, the intersecting points of the sinusoidal shape widen on one side into noncircular curves (Figure 26).

Let us now consider those lines which we had marked on the spiral band at right angles to the spiral axis. In the way that these vertical lines, in their projections, are grouped around the noncircular curve, we can recognize the turning process. *The vertical lines circumscribe a turn in addition to the spiral rotation* (Figure 27).

In the case of the spiral, the turn is three-dimensional, i.e. a form that results from the interrelationship of planes. We can visualize this more easily if it is projected onto a plane.

The same lines both bore into space like a circular drill *and* form concavities.

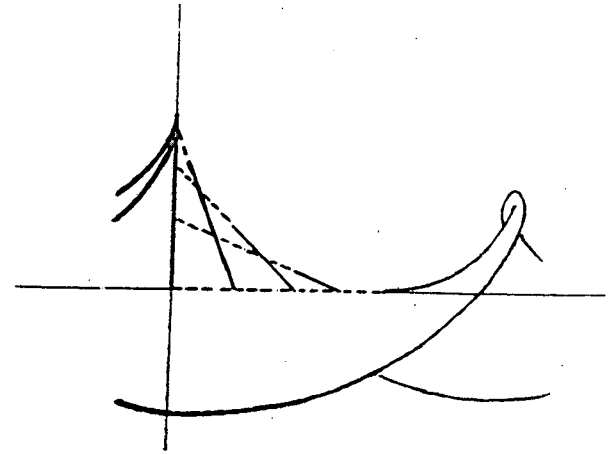


Figure 27

Bore forms are important in machine technology. The principle of the propeller brought the human dream of flying to reality. The wing beat of a bird in flight, however, contradicts all mechanical principles since it forms organic concavities into the air. In plant growth the "spiral tendency" unites circular earthly movements with cosmic forms of turning, the former prevailing in the shoot, and the latter in the flower.

Space Boundaries

A space resulting from the interplay of separations and extensions generates boundaries everywhere in order to join them together in forms and fields. Wherever there is space there are also boundaries. In spite of this, the old question

remains whether space with all its forms comes to an end somewhere and changes into a non-spatial form of existence. If our universe has a certain diameter, is it surrounded by empty space?

When it became usual in modern mathematics to deal with infinitely large and small values, the school of projective geometry tried to formally define infinity. In order to construct the geometric limits of space, it describes, among other elements of a "geometry of infinite distance", the formation of one infinitely distant point out of two determinate ones which move apart in opposite directions. Einstein tried to reach a similar goal with his hypothetical fourth dimension in which time, as well as the point in infinity, would become part of an expanded space concept.

For the Goetheanistic science, which was developed further by Rudolf Steiner, space is a perceptible phenomenon. Anything that on principle cannot be observed is rejected by this method as an unscientific hypothesis. The boundaries of space are determined by its observability. Where does it begin and end?

As demonstrated above, separations, lines and surfaces are perceptible elements of space. Likewise perceptible are the extensions and interstices that are enclosed by the boundaries, and those surrounding them. The space content of a room and the yard around the house are external experiences from childhood on. The experience of the surrounding yard is capable of expansion. Obviously, the concept of such a yard becomes meaningless when it is by definition no longer perceptible, and when it loses any connection with the house — geometrically expressed: the boundaries — to which it belongs. For the scientific method applied here,

therefore, a perceivable and recognizable exterior space exists geometrically *without* infinite distance. For the same reason I consider a space "a million of light years" away to be unreal.

Is it possible that exterior space changes at its boundaries into spiritual space? Here clear concepts are necessary if confusion is to be avoided. Spatial phenomena at each level are external perceptions which are comprehensible. If the spatial concepts are not abstract but alive, they bear witness to the emergence of spatial forms born out of spiritual creation. The scientist knows his conceptual world and observes its inner life. Wherever he recognizes geometrical forms, he sees through his spatial concepts and knows how to distinguish them from external spatial perception. Only then can the inner life connect with the outer object. The conceptual life never completely reaches its goal. It would like to make smallness into a point, narrowness into a line, and flatness into a plane. For concepts external things are inaccurate. Concepts cannot, however, generate an absolute geometry because their world possesses neither external extensions nor separations. I have to be content with the outer world as it is, without imputing to it a nonexistent precision. At the same time I try to sharpen my view for something new that is encompassed within the zones of presumed imprecision. An external line is fuzzy. My concept wants it to be clean and straight. Between these facts lies a gap which cannot be completely closed. On close examination the gap is full of life, giving rise to action, impulses, and the interplay of forces. Let us admit that the whole of geometry consists of gaps of this kind. We are discovering the joints through which life streams into the outer world.

The same happens the other way round with great distances. The conceptual life wants to unite everything that is spatial. It strives after the infinite vastness that the outer world does not possess. The most distant point is still too close because beyond it space expands further. The point that moves away along a line goes "through infinity" and reappears at its other end. What ceases to be accessible to our outer perception is supplemented by imagination. The life of concepts gets lost in the infinity of space. As long as it is content with the reality of observation, it recognizes external space as finite. Instead of a constructed and calculated infinity, it finds a spiritually active periphery that becomes the content of both outer *and* inner observation.

External Space has only Three Dimensions

Are there more than three dimensions of space? As we follow Rudolf Steiner's outline of the Goethean concept of space, we expect answers neither from geometric nor from mathematical procedures. That is because the problem's solution is rather to be found in the way the observer cognitively approaches nature.

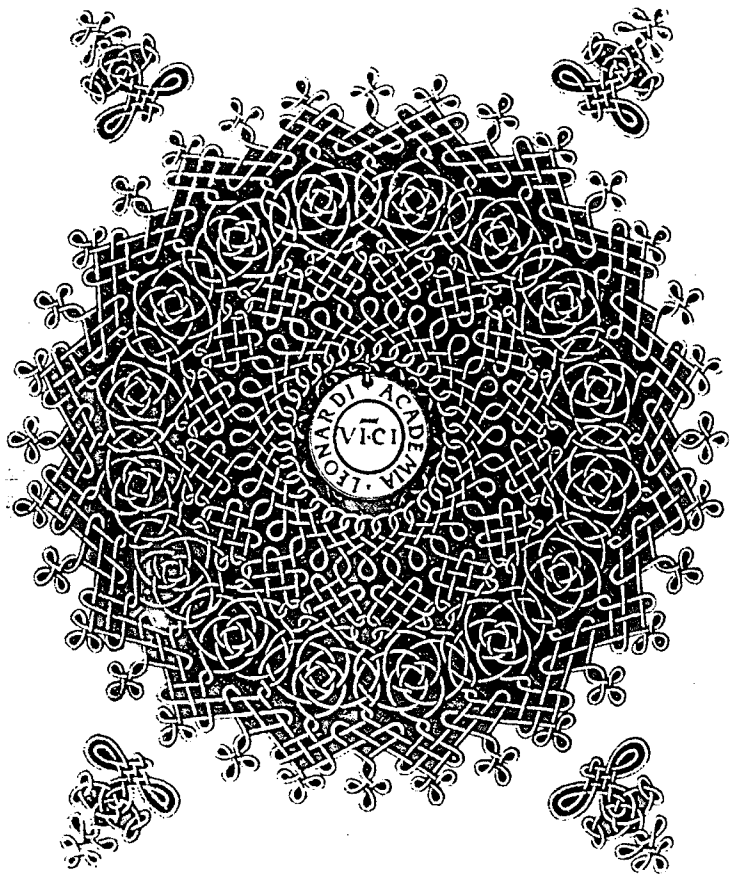
He comprehends the uncomprehended and raises it into the polar dynamics of outward-inward: First dimension, succession of separations and extensions to form distances.

He comprehends within the dynamics of outward and inward what creates *both*, his thinking. Separation and extension are known as *one* entity, the line and all its interactions: Second dimension.

If the observer does not just view his thinking insofar as it brings polarity to interaction, but if he observes *thinking*

itself, its life, clarity and unity, he comes to know how all shapes in space tend to flow together into creative unity: Third dimension.

Any place in the outer world from which thinking has withdrawn all its unifying force cannot be further divided. There are, therefore, no spatial phenomena beneath the separations. Similarly, nor can a spatial combination exist that goes beyond the unity recognized by pure thinking. The space-creating unifying has returned to its origin. This is the completion of external space brought about by the inner world, and it clearly shows the impossibility of "curved space" within a fourth dimension. Such a curve would have to form an angle, which means presupposing three-dimensional spaces separated from each other. But it is essential to the third dimension's formation that it achieves a spatial unity complete in itself.



Knot, engraving after Leonardo da Vinci, ca. 1499

THE LIFE OF MOVEMENT

Reality and Science

In ancient physics, especially that based on Platonic thought, it was taken for granted that all perceived movement was, directly or indirectly, the result of spiritual activity. Man was the measure of all things. He was capable of raising his spirit in self-knowledge to the very origin of creation. From the age of enlightenment onwards it also became taken for granted that in physical reality only inanimate "material" movements fell to be considered. The outcome was an insurmountable gap between the observer and "material" reality. What entitles an observer's mind to make a valid statement about something which he is not himself? He is only justified if he derives the material reality from within himself, or his own self from matter.

For Einstein there was a strict separation between science and religion, although his convictions were deeply religious. To him the thought of God, who can create nature and also physical energy, had no place in physics. Einstein did not search for the cognitive basis of movement, even though the velocity of light forms a centerpiece of his physics. He took on the Euclidian space components — point, line, plane — as axioms which do not require any further explanation and considered time to be a one-dimensional succession of seconds. He described movement as a change in the space-time

structure. Einstein researched the measurability of space, time and movement. His conclusion was that the same object, at a given moment, could be viewed as being in motion as well as being at rest because he considered all motion to be relative.

It took centuries for mankind's view of nature to become as completely demythologized as it is today. Lightening and thunder have ceased to be the language of gods, clouds are no longer the abode of angels. Imagination and belief were replaced by calculation. Disillusionment reached the point where technical thinking became the only tool used by science. But our "enlightened" scientific consciousness is presented with a difficulty resembling the situation in ancient physics. The "ancients" had included their imaginations of storm- and thundergods, vital force and other elements in their observation of nature. They were therefore unable to obtain accurate experimental results. Nowadays we still confuse observations with preconceived views and naive opinions. The physicist describes how "a body changes its position in space in the course of time." He links the velocity v with the distance d and the time t into the equation $v = d/t$. Instead of observing space, time and motion, they are made into the basis of calculations. It is convenient to keep to the traditional notions of space, time and motion without checking them against reality. In this way, basic errors have slipped into the contemporary theory of motion, such as the assumptions that geometry is not an empirical science, that time is one-dimensional and that, in principle, motion is a uniform process.

The Origin of Movement

Our scientific research needs more than everyday intelligence. We have to apply the sharper tool of more highly developed thinking and observation. Just as a violinist acquires his virtuosity every day anew by practicing, so does the scientist need to prepare the instrument of his pure thinking and observation anew in daily meditation. Such meditation is directed in loving contemplation towards the kingdoms of nature including that of the human doing, feeling and thinking. It then has to pass through the needle's eye of the experience: *I do not understand what is out there. There is something that is not myself.* At this point everyday-thinking is eliminated. The reference to what is outside myself is clearly present, transparent, constant, and is a complete oneness. This reference rests upon itself but I have to create it in order to see it. In the basic concept of the outer world (page 9) the life of pure thought reveals itself. In pointing beyond itself, it indicates contents which can only be present when thinking withdraws completely. Pure thinking turns into pure observation and looks upon what exists externally.

My thinking comprehends both itself and its creation of self-relying concepts which in their validity are not limited to me as person. My thought life is powerfully active. Why should it not have the ability to work beyond itself and to bring about the impossible by means of willing? When outer impressions meet the life of thought within me so, too, does thinking meet the outer impressions. At the moment of this encounter, thinking by necessity expands beyond itself towards the external object and creates an external effect. A vista is opened up towards a reality ignored by contemporary physics. Our thinking gives us insight into an inner

world of absolute concepts. By its living force, it allows us to participate in the creating process as well as to recognize outer reality as creation.

Every concept has a life of its own. The concept of the *external* creates resistance as it enters into the external world and brings about emptiness as it holds its activity. If a researcher merely registered how spiritual forces touch the outer world, he would never comprehend time, space or movement. He would be like the audience in *Il Pagliacci* that failed to perceive the human being behind the clown's tricks. Outgoing activity and withholding, being the means of contact between the spiritual and outer worlds, have a common origin. The realm of outgoing and withholding activities is, generally speaking, a shadowy experience. The sphere of these activities' origins is completely overlooked. At this point, the observer has to take the inner step into the realm of the origins. The stream of time does not only consist of the outgoing and withholding of the externally creative forces; it pulsates in the changeover between the outer engagement of the *polarity* of activities and their return to their origin.

Our observer learns to look at his own thought life. He sees in it the powerful inner ground of existence which, reaching out beyond itself, meets the outer world. External effects arise and disappear. The encounter enables the observer to regard himself, as it were, in a mirror and to develop his faculty of inner overview. Each external effect is now endowed through the inner overview with an image that creates a spatial form in the outer world. Time is closer to the spiritual origin while space is the outcome of the forming-out process. We gaze at the Sistine Chapel walls and try to unriddle the brush strokes of the master, who saw the

world evolution before his soul. The dead spatial picture points towards its origin. Its figures wait for the viewer so that in his imagination they may receive back their animated life.

Thought life weaves between its basic ability to reach forcefully beyond itself and its ability to focus on inner overview. The outgoing inner force would like to return to the center of insight; the insightful picture wants to become part of every action. The researcher discovers an area of his thought life that is more than either overview or outreaching activity. It is a realm able to contain both inner overview and outreaching activity in an interweaving unity. Here is the origin of movement. The concept of movement lies in the sphere where conceptual life itself originates, as do the concepts of space and time. It exists in the inner movement that thinking is continually carrying out by means of its primeval ability.

The Basic Phenomenon of Movement

The experience of outer movement is so deeply ingrained in our life from the first day on, that everyone tends to believe that we all know what movement is. Hence, scientists do not search so much for the essence of movement as for its interconnection with other phenomena. Aristotelian teaching was primarily concerned with the connection between movement and time, seeing a spiritual primal mover as the cause of all motion. Contemporary physics is interested exclusively in mechanical motion and its spatial connections.

A physicist schooled in intuitive observations cannot be content with the mere combining and ordering of natural

phenomena. The basic question is for him: How does a particular physical phenomenon originate out of the creative power of thinking? It is not sufficient to define motion by mathematically combining entities which are not motion. Instead of applying conventional concepts, our physicist tries to exclude all orthodox theories from his field of observation, admitting only ideas he has thoroughly developed himself, like those of outer force, time and space. Movement presents itself as an uncomprehended entity within comprehended phenomena. To investigate the new entity, he follows the same method he used for understanding force, time and space, i.e. he observes what is present in as unprejudiced a way as possible. He pays close attention to the reactions the object before him brings about in his thinking.

The impression that *something moves* has the same meaning at first as *something happens;* the observer is activated. An unexpected impression of movement makes a car driver, like an animal in the hunting field, highly alert. If it is an anticipated movement, the observer quickly matches it with active imagination; the inner movement easily measures up to the speed of the outer movement. Consider your body. Your eyes see a bird of prey in flight which holds your attention. At the same instant you find its flight circles not only in the impressions on your retinas but also in the accompanying movements of your eye and neck muscles and hence of your whole movement system. The outer movement gives rise to inner participation on different levels.

Movement is apparent in various ways within the different realms of nature. In the mineral world rest is dominant. The watery element is always in a state of flow; the air's mobility is even greater. Warmth is in a state of movement

but also in a resting state. The visible movement of a flame results from the interaction of heat with the air. Warmth by itself is restful, radiant and penetrating, causing motion without itself moving.

Movement also appears in different forms in the spheres of organic nature. Whereas movement in the plant kingdom is mostly passive, in the animal kingdom it is actively shaped by animate life. In the human sphere movement takes on a completely new quality embracing thoughts, experiences and actions that reach beyond the life of the individual and his kind.

Out of the great variety of movements the observer chooses a convenient example. — Traveling on a train, he looks at the countryside through the window. Hills and villages emerge and disappear, springing out of one side of the window frame and being swallowed up on the other. When the train goes slowly, the traveler perceives how a splendid church disappears bit by bit at the window frame. The opposite takes place at the other side of the frame. The disappearance boundary in time turns into a shifting spatial boundary.

The traveler perceives spatial distances and forms, as well as appearance and disappearance in time. He finds within space and time something which exists in the connection between them, although it is an entity on its own. In order to learn more about this entity, the traveler stretches a thread vertically down the coach window, thus bringing the events on both sides of the window together in one place. The landscape disappears, as it were, into the thread in order to reemerge immediately. Half of the church has disappeared on one side of the thread and has reappeared simultaneously on the other. How can this be understood? The basic tempo-

ral processes of disappearing and reappearing do not necessarily have to succeed one another. They may occur side by side, forming *one* process. In such a case, however, only part of the object can disappear while beyond the line new things are appearing. The spatial separation here comes about in a special way, i.e. through the disappearance of part of what is spatially present. We have a separation in space *and* time in that spatial unifying and the creation of duration both withdraw to their common origin. It is that origin where space-creating overview and time-creating renewal unite in inner movement. The inner center responds to this joint withdrawal by sending a movement impulse into the outer world. Viewed from outside the process manifests itself in the disappearance of spatial objects on a dividing line, dividing point, or dividing surface, and their reappearance out of them. It is the basic phenomenon of movement.

Change and Formation

Let us put ourselves into the mind of a physics student. In his search for the concept of physical motion, the student finds the definition of velocity to be the distance "covered" during an interval of time, all further mathematical equations of motion being built on this. The more the researcher studies this definition the less he finds in it an answer to the questions, What is movement? How is movement supposed to arise from a distance in space and an interval in time? How does the "rigid body" get from A to B? Who guarantees that the body found in position B is identical with the one that left A? The student begins to see: "Movement remains an empty definition, as long as I do not associate myself with it. The

changeover from the disappearance to the reappearance of the body is made by me in my thought movement. It is *my* body and none other."

The student learns to observe his own thought movements as objectively as the course of an external movement. He watches the clouds passing. One morning, except for a narrow band, the sky is covered with a gray blanket of clouds. The overcast recedes within a few hours, forming a clear contrasting line with the radiant blue. Our student notes that the cloud border disappears in one place in order to reappear in an adjacent place. He notices the absence of the edge at one location and its fresh presence nearby. Between both locations an interval extends with both spatial and temporal character. To describe it, the student would have to invent a geometry of arising and passing. In such a geometry spatial extension would be the bearer of a spiritual activity. The unifying force brings about something new in the outer world, dissolves separations, and brings together spatial expansions. Once the activity has become externalized, it has left its origin, and becomes onesided, narrow, limited, finally fading away.

Viewed through living thoughts, the temporal and spatial elements of cloud movement come into a mutual order, unfolding an unexpected life of their own. The disappearance of the edges and the expansion of the blue sky belong to one another as a process of outgoing spiritual activity. The student formulates: *Interrupting causes separation to disappear; persisting creates extension.*

On the other hand, he recognizes that the appearance of the new edge forms part of the same process as the disappearance of some of the cloud cover, for the result of the

spiritual reaching out is no longer fresh and nears its end. He formulates the process as the reverse of the earlier one: *Interrupting makes extension disappear; persisting holds on to separation.*

The student calls the first process *change*. Spatial forms are dissolved and are affected by the new content that arises. He calls the second process *formation*. What was active in time as interrupting, solidifies in space and prevents new contents from arising. The nature of change and formation becomes apparent. Formation, where temporal interrupting goes out completely into space and crystallizes there into separations. Interrupting disappears from the realm of time, where it is now persistence that dominates. Change, where the temporal interrupting is freed from spatial rigidity and enabled to bring spatial structures into flow. Change and formation are movement's basic elements, each seeking its balance in the other. It is the nature of the changeover between space and time to come to rest in space, so as to rise up afterwards into the changing world of time and then to become spatial once again. Movement is by its nature rhythmical whether it be the human gait, the flight of a bird, the vibrations of the wind, a bouncing stone or, in mechanical motion, the motor piston in an engine.

The example of the cloud may illustrate how change and formation bring about the movement intervals. The cloud edge moves across the movement interval from the first edge's disappearance to the reappearance of the new edge. The more frequently the observer follows the stages of the constant transition, the smaller the movement intervals become. The newly formed edge moves closer and closer to the one disappearing. The result is one moving, fading/arising

edge, on one side of which extension comes about, and on the other side of which extension vanishes. The bright part of the sky increases while the overcast part decreases.

Should the dark layer of clouds develop a second boundary line some distance away, and should this line move in the same direction as the first one, the adjacent, brighter part of the sky would diminish, and the darker part would increase. A broad band of clouds would move with both its boundaries across the sky. The succession of a number of boundaries shifting in the same direction forms in its transitions a linear field of movement. Boundaries become transfer spots in time and space, surrounded by arising and vanishing extensions. In the pulsation of change and formation, one movement interval follows the next.

The student is looking for the actual sphere of movement in the time-space transitions. Does motion take place half in space and half in time? His inner view of the power of thought has led him to understand passages of time; combining them in an inner overview has led him to the concept of space. The concept of movement derives from a yet further enhancement of the intensity of thinking, in which the researcher experiences the *life* of his thought force within his inner overview. If thought life can achieve this enhancement, it can penetrate even more deeply into the outer world. The sphere of external movement is not located only between space and time but embraces the whole of space, which it expands, deepens and shapes. The inner life of the outgoing movement brings about temporal events that seize and transform spatial structures; it crosses the boundary between time and space, which is also that between the inner and outer worlds. Not content with the projection of this archetypal

boundary into space, it sweeps the projections away in order to create them continually afresh.

The outcome is other relationships of becoming and vanishing. As the time-space boundary is pictured in space, an object that moves in space disappears only as far as a *spatial* border, reappearing immediately beyond that border. Arising and passing both take place side by side within space. In fall, a plant's shape dissolves, and its shape is preserved in the realm of time, so that it can be brought out again in space in spring and summer. It crosses the archetypal boundary each time between the inner and outer worlds. A deer disappears from the garden when it jumps over a fence and emerges at the same time on the other side. The animal's life of movement takes place in this appearing and disappearing within space and time. Its body's outer movement stays within space as it goes from one place to the next. In recognizing movement in space, whether living or mechanical, the observer always adds to it conceptually the inner movement in the realm of time.

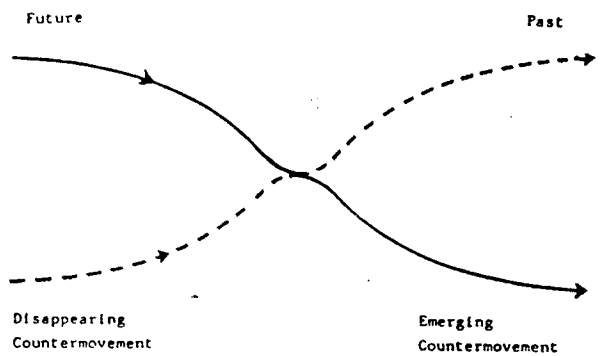
Countermovement

Motion results from the coming into being and passing away of spatial structures. Whatever takes shape in space stays incomprehensible until its temporal counterpart is taken into account. The process of movement in space has its own counterpart in the realm of time.

Say, I intend to visit a friend. In my imagination I can visualize the different points on my journey up to the moment I meet my friend. When I actually make the journey, I pass through the visualized points in external space. I go

from one place to the next, as I move from my house to that of my friend. My expectations become reality from place to place. An event may or may not match my expectation; when it happens, it replaces the expectation. The time stream of the succession of expectation images ends in the present, to spring up anew immediately as a stream of memory images (page 32). As a traveler, moving along or being at rest, I am the active point of transition in the present with my action causing a time stream to flow both towards and away from myself.

Movement in time is inseparably connected with my movement in space. Its features are the exact reversal of the spatial process. The stream of time moves in the opposite direction to mine in space. As I move towards my friend's house, in the stream of my expectation images the house moves closer and closer towards me. When my body crosses the street, I am moving in space while the street and houses around me are at rest. In the realm of time, however, I and my activity are always permanently in the present, immersed into the stream of expectation and memory images.



These features of time are well known to us from experience. They correspond in detail to the impressions made by

the apparent countermovement in space. The highway is speeding towards the car from the front and away from it at the back. Similarly, trees, gardens, houses seem to hurry by, as a train traveler looks out of the window. We recognize the phenomenon depicted by the thread stretched vertically down the train window (page 95). It is the basic phenomenon of movement as it presents itself in space, having come from the realm of time. Temporal activity shapes new forms that come from the future, dissolving old forms and releasing them into the past. This stream of time that touches the spatial present is intrinsic to every movement. In turning expectation images into memory images, I reach out into space and bring it into movement. Movement that is conceptually alive and external movement are joined together in a unity. When a mechanical external motion comes into view, the observer's "eye" adds the life of movement to the process. In the process of seeing, the onlooker accompanies with his active inner experience movements, such as that of a waterfall, and in this way approaches the essence of the natural phenomenon.

The Movement Plane

Two movement rhythms may proceed alongside each other. In a race each horse has its own rhythm, though the movements of all the horses are similar. In spite of their individual character, the movements of the different horses are in exact accord with one another. They call for comparison in skill, speed and elegance. A new dimension of movement opens up between the individual movement rhythms, uniting them in a wider phenomenon. This we call the *movement plane*.

Suppose a larger group of horses is galloping in two lanes, the left one slower than the right one. A rider in the left lane has to change to the quicker lane as he tries to overtake his rivals, and therefore changes his speed as well as his direction. We perceive two movement rhythms, one quicker than the other. Each, on its own, continues steadily in a line and belongs to the first time-space dimension. Taken together, they move in a relationship to each other. They open up between them a plane where a third movement rhythm can arise. What now takes place belongs to the next higher dimension. The third movement rhythm may align itself either with the first or the second; in this way it approaches as a line to one of the original two movement lines, and thereby describes a plane. Timewise, it comes closer to the quicker rhythm when it accelerates and closer to the slower rhythm when it slows down. It swings back and forth in the field of harmony in time, comparable with a melody that sometimes aligns itself with the quicker, and sometimes with the slower accompanying voice. Through the accompanying voices the harmony field surrounding the melody sounds forth. Similarly, a change in velocity is only complete as a phenomenon if the corresponding original movement rhythms are part of the picture. Then it becomes evident that acceleration, change in direction, and movement in a curve are attributes of the *movement plane*.

The Separation Field of Movement

A geometry of intervals with temporal as well as spatial character encompasses the multiplicity of its interchanges. In a line of ants, for example, the beat of the tiny steps unites

into one great time-space interval pulsating at the rate of one common beat, forming a linear field of movement. A similar field of movement, which could have the same velocity, may be formed some distance away by a second line of ants. In order to bring both lines closer to each other, the ants would have to add sideway steps to their linear processions. The whole line then would move sideways.

Similar movements, e.g. the course of a ship being steered eastwards but being diverted by a southerly ocean current, are often depicted by parallelograms. Two sides represent the two directions of movements together generating the new direction that is a diagonal between them. This is nothing more than a diagram obscuring the true nature of the process. For the three directions represent fundamentally different events. First we have the stepwise one-dimensional movement rhythm, then its lateral shift, and finally the new resultant movement. In the linear rhythm, the interaction of change and formation is still visible. In the lateral shift, the whole linear process is subject to the shifting rhythm. The outcome is a third movement of a new character in which it is only the *context* of the first two rhythms that matters.

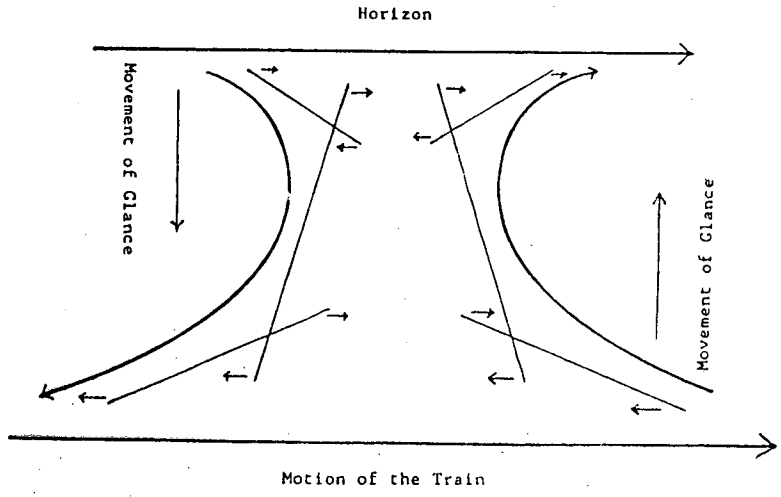
The Extension Field of Movement

When the lateral shifts of parallel movements all manifest themselves together, a further kind of phenomenon is encountered. We observe once more the race where the slowest horse is running in the left lane and the fastest horse is galloping in the far right lane, both followed by competitors of equal speed. In between, there are further lanes with intermediate speeds, making a transition between the outermost lanes. Let us look at the lines which form across the lanes. The first horses in each lane form the leading cross-line with the other cross-lines behind. A rider, who would be able to jump from one horse to the next, would move at the same speed within his own lane. If he were to do the same along a cross-line, his resultant speed would either increase or decrease. The race as a whole depicts a movement field that proceeds in any of its lengthwise sections with constant speed, but is accelerating or decelerating in each cross section.

The movements of the cross-lines meet the criteria for an extension field (page 65). They obey a higher functional law than the lengthwise movements of a separation field (page 63). What is rigidly manifest in space comes to life again in the process of movement. An everyday experience, which is a remarkable example of rotating and turning movements (page 68), is the optical shift of the landscape when viewed by a walker or train passenger. The further away from the observer, the more slowly the trees, houses and church towers seem to pass by. As long as the train travels in a straight line, the horizon appears as motionless as the stars. The traveler perceives a variety of parallel countermovements, each taken by itself at equal speed, whether it be the slow progress of a distant churchtower or the rushing by of the trees and fences close to the track. One might expect the rows of a plantation, or the streets lined up at right angles to the train, to rotate like the spokes of a giant wheel with its center lying on the horizon. However, experience shows that the distant parts of the scenery do not just rest but follow the onlooker's movement, and do so the more quickly the less they are hindered by the countermovement. The world

seems to be grasped by a whirl that just begins to turn before it is swept away.

What is happening? The rotation of the giant wheel is at every moment opened up, since no steady center of it can be kept in focus on the horizon. The eye tries to find a point of rest somewhere in the landscape, whether it be in the far or middle distance, or even close by. For a moment, the landscape revolves around the point of rest, which, however, moves on because the glance ranges both far and near. Whenever the glance shifts from nearby to far away, the optical lines at right angles to the train twist around, forming concave shapes that are open in the direction of the train's movement. When the point of optical fixation is shifted from far away to nearby, concave shapes result that are open in the opposite direction. The phenomenon reveals a moving extension field with the whole dynamic of turning. It shows, furthermore, how field separation and field extension are two



Apparent shifts of the landscape as seen from a moving train

aspects of a movement field, where linear-rhythmic movements unite to form a harmonious movement composition. We find ourselves surrounded by flowing shapes which our own movement helps to create.

Three-Dimensional Movement

Movement is apprehended on three levels. The first shows how movement's nature transcends its intrinsic sphere to engage with the outer world and thus unite the basic structures of time and space. Through formation and change, the pace of external movement becomes visible. Movement begins to develop a life of its own as it links one step with the next. Linear and rhythmical continuity are the outcome.

On the second level, the life of movement grasps its own outgoing activity uniting its separate steps. What matters is no longer the sequence of steps but their speed, direction and alteration. The steps are raised above separation and interruption and start to swing, as movement itself comes to full expression. In a dance the sequence of steps changes, each course merging harmoniously into the next. On this level, movement creates an artifice of forms in which all the events are attuned. Each relationship is still in harmony with the individual steps, and this harmony is in each case exactly determined. It is a movement field that at any moment, and in any place, can produce swinging movements, rotations and turns. But it cannot change its mood without more ado. A four-four beat would interrupt a waltz.

Here we have a possible further level where the movement origin itself turns towards different harmony fields. A

dancer, changing over from a waltz to a tango, pauses for a moment in order to adjust to the new movement field. The same would apply to a farmer who couples a tractor instead of a horse to his cart, or to an actor who changes his role. Transition between movement fields of this kind is an essentially human achievement. That which moves recalls its own inner origin. The concern is no longer with joining up of the steps or the coordination of their flow but with the creation of any kind of movement from within the moving self. The movement life goes back to its spiritual origin in living thinking. How does this level of movement appear in the outer world?

The highest kind of movement appears in the union of movement fields. This primeval movement does not desert its inner center and therefore contains no separation or interruption in its appearance. Its radiance is reflected in the outer world; it appears in that part of the radiance that is not earthly. It is the unity and permanent condition of creative rest from which contexts of movements continuously emerge in new and varied forms. We describe the primeval movement's external appearance as the *three-dimensional movement field*, and all the possible compositions of movement harmonies derived from it as three-dimensional.

Real three-dimensional movements belong to the realm of human life, since they directly express the primeval movement itself. A person may engage in a succession of movements of entirely different kinds, such as swimming, playing an instrument, riding a bicycle, etc. He is capable at any time of creating these different movements out of insightful rest. The superior calm of human action is the external manifestation of the three-dimensional movement field.

An animal's movements show a pattern of pictures that are all related to the archetypal movement harmony of its particular species. These movement images arise from a more comprehensive movement image but not from the creative inner resting. An animal is not able to step out of its typical movement pattern and to decide to move differently. The third dimension has the inherent possibility of freely chosen movement which an animal cannot achieve. A deer's two-dimensional movement images, for example, merge into a comprehensive movement. This, however, only attains the third dimension in a one-sided way.

Movements in the plant realm appear as accompaniment to the flowing air and water. The plants' own movements, such as longitudinal growth and the unfolding of the leaves, happen so slowly that we have to recreate them in our mind's eye. Movement has almost come to be space. It stretches out, more strongly than that of the animal or man, into the realm of the external forces which are transformed into organic growth. Rhythmical linear movement starts in the root area and is enhanced to the second dimension in the harmony of the leaf formation which, in turn, finally unites to accomplish a blossom and fruit capsule. The latter encloses a three-dimensional space containing, in its seed, an image of the plant in its totality.

Albrecht Dürer, Melancholy, engraving, 1514

WHAT ARE NUMBERS?

Numbers have a remarkable relationship to time, space and movement. As the fourth member of the alliance, the world of numbers, too, needs other elements if it is to become manifest. Numbers order colors, tones, chemical and mechanical phenomena into a system; but without these phenomena numbers become shadowy. Since numbers are even more abstract than time and space, their world is often described as an entirely intellectual product and as not requiring verification by outer perception, except when necessary to demonstrate the first steps in arithmetic to a beginner. If this were true, numbers would be solely spiritual phenomena and different in principle from natural phenomena such as gravity or heat.

The concept of the number three is transparent, unchanging in itself, and a unity. It has received these characteristics from pure thinking. In addition, its content points toward things that are different and separated from each other, i.e. elements which can be experienced in the outer world. Hence, numbers are part of the outer world and objects of natural science.

When we use numbers to count events that follow one another, or to count neighboring objects, it becomes obvious that numbers are applicable to both temporal and spatial phenomena. Why do numbers fit in with time as well as space? Let us recall the difference between interruption in time and separation in space. The concepts *interruption* and

separation both come about when externally directed, concept-forming thinking withdraws to its inner center. If this is done by the outward-directed power of thought, time arises. The response to the drawing back is an outgoing swing of power that causes external creation. In the creation of space the force of thinking, intensified through inner overview, withdraws to its center. The response is a counterswing, which is broadened into a picture, into the outer world. The thinking, thus enhanced, has the urge to work back and forth between the sphere where it works beyond itself and the sphere of its inner overview. It observes its own life. As such an enhanced thinking withdraws into itself, it leaves an interruption which is both temporal and spatial in the outer world. Its outward swing then creates movement.

This thinking can be further intensified. The inner *life*, in which thinking moves to and fro between working beyond itself and centering in insight, is a primeval capacity. It is the purest form of thought and basic to all types of thinking. It not only moves to and fro between thought's other faculties but produces them and brings them into interactivity. While still remaining self-contained it emanates, illuminating and uniting all activity. Temporal and spatial effects become entities of movement. An external structure arises and decays in its own time rhythm. It separates itself from other forms in space and is permeated by its own rhythmic movement. The real thought life comes to expression in the creation of organisms. If it turns away from the outer world, its outer forms collapse. What remains are the most complete separations, extending equally to the structure's manifestation in time, space and movement. Such separations are numbers.

Our intellect does not view numbers as the dead remnants of organisms because conventional thinking does not grasp its own inherent life. The science of Newton and his successors raised mathematics to the highest perfection. At the same time it blocked all connection to its thought origin and turned mathematics into a soulless technological tool. The *monad theory*, developed by Leibniz, Newton's great contemporary, is to present-day conventional thinking a mere curiosity. The elements of the "substance" are said to consist of extremely small "entities" that possess both material and spiritual properties. Leibniz called them "substantial points" and "sources of activity". Substance itself has been created by divine powers and, when reduced to point size, reveals its inner life. — Is this not the stage of absolute separation where the formative forces draw back from duration, extension and movement? Externally, all that remains are numerical differences. But the "sources of activity" reveal themselves to the mind's eye which can now perceive their outwardly directed swing on the way to becoming an external organizing force.

Similar references to the essence of numbers are to be found in Novalis' fragmentary scientific theory. "Every human being, etc., is a calculation, just as every calculation is a human being". Novalis perceived in mathematics a magical power he termed "life at its highest". The life of numbers is of divine origin. As a consequence of its own nature, it forms a whole human being.

In arithmetic the structural theory of time and space comes to an end. It proves to be the precipitate of the inner region where thought forces engage and disengage in forming living concepts. The laws of polarity and enhancement hold even greater sway in this sphere of origin.

Time creation:	The force of thought works beyond itself in forming living outer action.
Space creation:	As a counteractivity to working beyond itself thinking arrives at an inner overview and works outwards from there.
Moving:	Thinking finds its enhancement in an inner life from which both activity and counter-activity emerge together.
Organizing:	In the interaction of inner movement between the creation of time and space, that thought life, which is the basis of all activity, prevails. The processes creative of time, space and movement join together to form an organism.

The world of numbers is the glittering reflection of the organizing life. We do not perceive its inherent life because our sense for the "spiritual bond" is insufficiently developed. The realm of numbers, too, is in a wider sense three-dimensional. In the first dimension numerical separations line up in simple succession, giving rise to addition and subtraction. The true polarity, however, is to be found in the highest degree of separation and its counterswing releasing organic structures of both temporal and spatial character. At this point we can only have an inkling of the reality of the second and third numerical dimensions. In calculations, the second dimension appears as multiplication and division, which consist of the addition or subtraction of whole sequences of numbers. The combining no longer proceeds from separation to separation but from amount to amount. Counting is directed towards its own activity and achieves enhancement in many different ratios.

The ultimate abstraction from counted objects is to be found when numbers are "raised to the power of," or have their roots calculated. A number is applied solely to itself. Just as addition is connected with the formation of lines, and multiplication with the formation of planes, the method of calculating a number's power or its roots is related to the formation of the third dimension of space. Hence, conceivably, not only the cube of a number but the whole mathematical process of raising to the power may belong to the formation of the third spatial dimension.

A special mathematical field is represented by negative, irrational and imaginary numbers. They lead beyond external reality, as do excessively large numbers and extremely small fractions. By negative numbers we indicate what is externally lacking, e.g. debt. These numbers point towards both the past and the future. They have a connection with time's first dimension, flowing counter to the relevant spatial effects, forces and movements.

Irrational numbers come about through attempts to calculate incommensurable proportions like those of a circle and a square. While any numerical comparison leaves a remainder, ever decreasing fractions result. The latter measure two-dimensional spatial properties such as the steepness of a curve or the surface area of a figure. But since it is impossible "to square a circle," the fractions are perpetuated into ever smaller realms until all connection with the external world has been lost. What is left is only the activity of forming "ever more exact" proportions. The number Pi, and similar irrational numbers, lead beyond the spatial world into the inner world of activities in time.

Most mysterious of all are imaginary numbers, for example, the even-numbered roots of negative numbers such as the square root of minus one. Because a negative number multiplied by itself becomes positive, the square root of minus one is mathematically impossible. "Imaginary" numbers are, contrary to their name, unimaginable. Where do they lead our thinking? Normal numbers, with their powers and roots, are complemented by a mathematics of unreal, and impossible, powers and roots. Imaginary numbers point towards an area beyond spatial reality, as well as beyond numbers themselves. All that is left is the activity of mathematical thinking itself. In the sphere of numerical activity we reach the source of mathematical thinking.

A new light is cast upon the world of numbers by the process of homeopathic potentizing. Instead of counting objects, a time process is involved. The remedial substance is diluted in a proportion of one to ten, for instance, with water, and shaken. Then one tenth of the liquid is rediluted with nine tenths of water and shaken again. With each process the substance is diluted further by one decimal potency. After a series of potentizings, the original matter has spatially disappeared. But through the shakings the substance's forces have been impressed into the liquid medium. In the shakings the diluted substance impresses its formative forces into a medium that has already been exposed previously to the same very forces. These formative forces are thus reflected into themselves and strengthened. In principle, we have the same thing happening in the realm of substance as in the realm of numbers, where in mathematical "potentizing" the same number is fortified within itself. Through the activity of being potentized, the original substance is lifted from material

existence in space into an active state of being in time that cannot be computed with real numbers. We are no longer concerned with the counting of single objects. *Counting* directly creates rhythms, organizes and transforms what is externally present.

Theophrastus von Hohenheim
Paracelsus
1493-1541

Drawing (1526)
by Hans Holbein jr.
Basel,
Öffentliche Kunstsammlung

PARACELSUS, for the academicians of his time, was an inconvenient innovator; for the sick he was a miraculous healer, and for posterity he was the enigmatic alchemist and mystic whose writings were of a volume and depth difficult to fathom. During his unresting journeying through most of Europe, the great physician learned and taught not only at universities, but wherever he met patients and healers. At a time when medical training consisted almost exclusively in the interpretation of the writings of such classical figures as Hippocrates, Galen and Avicenna, he insisted on bedside teaching and investigated the connection between illnesses and the geographical and social environment. For him, knowledge had no value unless it was acquired "in the light of Nature" through both outer and inner experience. Paracelsus exceeded his contemporaries in the exactness of his observation. By virtue of his descriptions of medicinal springs, he founded the science of balneology. His contributions to the epidemiology of syphilis, and its treatment with mercury, continued to be the standard well into the twentieth century. Many of his treatises which

give the impression of being "medieval" are most probably in advance of our time; consider his descriptions of the "arcana", of the interconnection between the organs of the human body, healing substances, and planets, furthermore his writings on the elemental beings who live in the realms of earth, water, air and fire, and on christology.

Paracelsus led his life on the boundaries of existence. Often himself in danger on his arduous journeys, he had daily experience of suffering, death and the miracle of healing. He saw divine grace in healing as well as the presence of nature's spirituality. When he died at the age of forty-eight, he had laid the foundation for a medicine and science permeated by the spirit of Christianity.

THE ELEMENTS

Physical Force and the Force of Thought

In the course of their search for the causes and effects of natural phenomena, physicists from Galileo onwards have imposed upon themselves a constraint carrying serious consequences. They defined physics as the science of lifeless nature, denying without cause the possibility that living or spiritual forces be involved in the physical processes in nature. "The more a man is embued with the ordered regularity of all events the firmer becomes his conviction that there is no room left by the side of this ordered regularity for causes of a different nature. For him neither the rule of human nor the rule of divine will exists as an independent cause of natural events." (Albert Einstein, *Science and Religion*, 1941). A locomotive's traction is due to the pressure of the steam in the boiler that is caused by the coal's heat. This heat in turn, is derived from solar radiation which in the distant past gave its energy to the forests that later became coal. The physicist's causal sequences arbitrarily leave out of account any connection with living or spiritual causes. The system based on the laws of physics is deemed to be self-contained and complete.

Let us consider a comparable process. Suppose a railroad carriage is pushed by a group of people who, through their muscular force, cause a linear movement. This force comes

from the sum of their muscular contractions. It is a mechanical tension which can be compared with that in the boiler, although the steam pressure goes into expansion while the muscle tension contracts. There is a sudden warmth effect, the so-called initial heat, at the beginning of the muscle action. Can we investigate the underlying chain of physiological cause and effect in this case without taking into consideration the human spiritual activity?

If a person is the originator of his thoughts and of his deeds, there must be some originating quality within him which is the source of both. From Plato's philosophy we know that there is a common ground to all thought life. In the unity of thinking we find the unity of our own self-consciousness. The capacity for insight and the inner force with which we think are identical; but this force goes mostly unrecognized. If the thought force is alive and has its own being, what prevents it from reaching out into the external world and generating heat, for instance? In this case we would need a meditatively strengthened insight that would extend forcefully right into the movements of our limbs and cause the concept of warmth to become the creating of warmth.

Warmth as the Formation of Force in Time

In reviewing our concept of force (page 13) we find stronger and weaker effects going out into the external world from their common inner source. The source possesses its own life in that it either extinguishes in the interruption in time both the forceful effect *and* the void, or generates both together in the time interval between the two interruptions.

It does not matter for the time rhythm, in which passing away and coming into being take place, which kind of force appears. Within the same time rhythm it is possible for different color impressions, as well as sounds and mechanical impulses, to follow one another. Time is not identical with the forces at play within it. Time's essence is based on interruption which always necessitates new arising. Whereas a time rhythm consists of separate manifestations of, say, high or low tones, in the harmonious composition of such rhythms it is the proportions of all the parts to one another that are more important. The rhythms of time and tone merge into a unity. The composition's contents appear in the harmony of the musical rhythms. But if two pieces of music of very different origin, e.g. a Handel sonata and an Indian raga, are played together, what single notes sound like is irrelevant. In the sounding together of two different compositions no harmony is achieved. A gap opens up between them. For the attentive listener this gap contains a new phenomenon: The power of pure musical creativity with its diverse capacities for expression.

In this third time dimension it is no longer possible to differentiate between an interrupting time structure and an interrupted time content. What matters is the creative power itself and not this or that work of art. The power of time creation is present. In the interrupting, extinguishing of other content there is a content itself active, i.e. the force of renewal. Immersion into the outer world for renewal is an expression of the force of time creation. There is a clear cognitive element at work in this which is the concept of *outgoing activity at the level of the third time dimension.* The

exertion of force is no longer general; it is structured by the time concept. We call such an external force *warmth.*

Can it be proved that this concept of warmth applies to heat in physics? In the sense of molecular physics the question cannot be answered. For what is a molecule? How do molecules interact? "Particles" in motion may generate heat; but what is heat itself? An experienced nurse or a physician who touches the forehead of a patient is often able to sense a fever's state with the accuracy of a thermometer. He also knows the quality difference between febrile heat and normal or subnormal body temperatures. It is not that he just registers subjectively and relatively the temperature difference on his skin. At first he senses whether the patient's head feels warmer or cooler than his own hand; but beyond this, he seeks actively to encounter whatever warmth there is. As soon as he encounters it, he restrains himself so as to become receptive to its presence. He then perceives the external reality as it is and can say, "Warmth is present. In perceiving it, my activity unites with it. The more consciously I encounter warmth, the more clearly I can see in the constantly renewed presence of my outgoing activity, which is not yet structured in space, my own creation of warmth."

Primeval Warmth

When I shake a friend's hand, I reach out into the outer world. Where my action encounters the world of objects, a physical effect results. I ignore the fact that my hand exerts pressure on the other hand. I pay only attention to the effect of my action on the other hand, which arises and passes away before it assumes a particular spatial form. I arrive at a

concept of the simplest effect caused by my action. — I observe now the effect coming towards me from the handshake. I again ignore the pressure of the squeeze as well as all perceptions of form and movement. What remains is the perception of a force that continually arises and passes away without assuming a form in space. I find this content being identical with my first described doing. I feel the handshake's warmth, and in it I recognize the arising and passing away of an external effect at its simplest.

In the same way that warmth comes about through outgoing action, its absence, cold, is caused by the withholding of activity. The phenomenon of warmth is manifest in a simple series of higher and lower temperatures; it is enhanced in the harmonious correlation of temperature fluctuations, such as those in a climatic zone. Finally, it appears as the activity of a whole organism with all its harmonious and inharmonious differentiations. There is the higher form of warmth's manifestation which contains higher *and* lower temperatures. Unlike other physical forces, warmth merges with the activity of time into an inseparable unity. Warmth is the purely temporal manifestation of force.

The element of warmth expands weightlessly within solid, liquid and gaseous matter, penetrating and changing it. It connects itself to objects and thus assumes spatial properties. A kettle of boiling water contains a "quantity of heat"; one twice the size at the same temperature holds "twice as much heat". Although it is constantly arising and passing away, warmth extends far enough into the material realm to form the rudiments of quantity. It has no choice. In order to be present in the outer world, it has to come to terms with space. But it tries to ignore spatial boundaries, to pass

through them, to dissolve them, and to escape from them because it is in the realm of time that it is at home.

We can imagine a warmth organism with rhythmical temperature fluctuations that are harmoniously attuned to one another. But where can we find a form of warmth uniting in itself all possible degrees of heat *and* cold? The origin of warmth is present in all temperature transitions. Where warmth disappears, cold, the absence of warmth, appears. In the moment when it disappears, warmth is no longer present and cold has not yet appeared. Duration is a prerequisite of both warmth and cold. This moment of transition harbors both warmth and cold in germinal state, with all their intermediate possibilities. The germinal *primeval warmth* is physically just as real as the time boundaries in which it lives. As no completely uniform warmth process exists, all parts of any warmth manifestation are permeated by primeval warmth.

The Airy Element

If warmth is solely of time, what would a force possessing spatial properties look like? An enhancement of the warmth effect would have to take place, in which a sequence of rises and falls would be brought together into one common present, with this present being given duration. Warmth would be concentrated into *heat*. This concentration would be in contrast to a cooler, less concentrated zone. The concentrated part would tend, after a while to become less concentrated. A concentration of heat with a certain lifespan would be affected by another, similar effect. Instead of arising and passing immediately, each of the phenomena would maintain

its concentration instead of dissolving within its phenomenal counterpart. They would repel one another and form boundaries.

Such an enhancement in warmth generation has as its outcome a force that shows the beginnings of spatial form. The result is more than warmth. By being intensified into heat the effect reaches further into the outer world. What forms pressure as it concentrates, generates suction as it expands, and forms surfaces as it collides, is the new element *air*.

The concept of air as it is outlined here is crucially different from the molecular theory of gases. According to the latter an empty space is supposed to be filled with free-floating particles, the mechanical, electrical properties of which cause pressure and suction and all the other reactions of air. The minuscule particles, the "molecules", are construed on the model of solid pieces. In order to understand air it is, in theory, extracted from a vessel causing intensive suction and the creation of a vacuum. This void is assumed by the physicist to be filled with a number of tiny electrical particles, the total of which he calls "air". We have become by education and convention so used to the molecular theory of gases that we overlook its inconsistency by sheer force of habit. Molecules themselves are the subject of contradictory theories; they provide no basis for knowing what air is. Conventional scientists carry out calculations with "gas molecules" without connecting them with any picture of reality.

Here the path of physics divides. The choice on the one hand is for a physics that limits itself to lifeless objects and ignores its own thought life, and on the other for a science which includes the creativity of the observer. The cognitive

question for the new natural science is: *How does physical air arise out of spiritual activity?* A line of thought leads from primal thinking power, and its enhancement by means of the inner overview, as far as its effect in space in the outer world. With this concept we encounter air's external phenomena.

Air is perceived more as a vibration of pressure and suction than as a current. In each case the observer meets a subtle density and its quick alternation between arising and passing: "What is present is not only the immediate expression of an activity in time such as warmth is. Something acts counter to my own activity. It is the simplest encounter with what is outside my own activity." The resistance of the air calls for a counterforce from the observer. Resistance and counterforce are side by side in the outer world, separated by the simplest spatial boundary. This boundary possesses the character of a surface because it separates two unitary entities.

Air generates surfaces everywhere in nature, whether it be in leaf formation, the vesicles of the lungs or the surfaces of water, clouds or snow crystals. All conditions involving gas pressures and the related interchange of osmotic pressures take place at surfaces. Perception of the airy element demands of the observer the simplest encounter with space. Air is recognized as the first touch of the space-creating force in the outer world.

Air's Formation and Dissolution

In recognizing air the observer encounters it. He unfolds an activity that comes from his living thinking and is transparent. This activity generates an outer effect which extends

to the air with its processes of pressure and suction. As like encounters like, the observer generates external air. This may take place in barely noticeable ways in the tension and relaxation of the muscles, in the phenomena of osmotic pressure of the tissues and body fluids. It contradicts the ideas of conventional physiology. From the viewpoint of living thinking the fact cannot be ignored that the observer generates airy effects out of a physical nothing. — The moment he reaches the external object, he holds back his activity in order to perceive and recognize what is externally present in an unchanged state. A radical change comes about within the observer. The suspended activity no longer generates external air. In withholding his activity the observer draws air into himself, not only into his body by respiration, but into his spiritual inner life, too.

To be perceived, a part of the external has to extend itself into the observer himself. That means an encounter between two dissimilar things, i.e. the external air and the observer's inner self. This encounter calls for the utmost restraint, as any active interference would change the outer facts. Whatever is externally perceived has extended itself too far into the inner world. It is immediately seized and transformed by the inner activity, within which it brings about an inner effect that stems from the outer world. Through being perceived, air is transformed into air-creating activity. Thus we should expect that traces of air disappear from the outer world to take on an inwardly active form of existence.

Johann Wolfgang von Goethe
1749-1832

Detail of a Painting by
J.H.W. Tischbein,
Rome 1787

GOETHE said in his old age to Eckermann: "Excellent poets were my contemporaries, even more excellent ones lived before my time and more will always be there in the future; but it fills me with satisfaction that in my century I am the only one who knows what is right in the difficult science of color theory." His theory of colors had been rejected by the scientific world for decades. The stronger the resistance, the more determined Goethe's commitment to his insights became.

In "Truth and Poetry" we read about the young man's severe illness, of his friendship with Susanne von Klettenberg who belonged to the Herrenhut community, about their joint alchemistic studies that included the writings of Paracelsus, and also about a mysterious salt remedy. Through these experiences the young Goethe came to realize deeply the connection between nature's works and human life.

His discovery of the human intermaxillary bone (1784) was the result of thorough investigation. His interest lay in the evolution of the particular out of the primeval form. In the course of his journey to southern Italy, Goethe received the crucial impressions that led him to the discovery of the archetypal plant and of the Ur-phenomenon of light. On his second Italian journey (1790) a shattered sheep's skull revealed to him the metamorphosis of the archetypal vertebra into the form of the skull including the facial bones. In the same year the first edition of "The Metamorphosis of Plants" appeared as well as "Faust, A Fragment". At this time his color theory had already taken shape, but it would be almost another twenty years before it was completed. The "fortunate event" of a conversation with Schiller about the archetypal plant laid the foundation for the friendship between the two poets. Schiller's remark "This is not an experience, it is an idea" helped Goethe to develop his "philosophical gifts". After 1810, Goethe published contributions in the fields of geology and meteorology. Basic essays, like "Concerning the Spiral Tendency of Vegetation", were written in the last years of his life.

Goethe was able to observe natural phenomena with a poet's insight. He developed over many years the method of imaginative thinking which is able to grasp the archetypal phenomenon, the living formative principle in natural phenomena.

Light and Space

Air formation can be described as warmth formation enhanced to a higher intensity. Sequence in time is condensed to coexistence in space. Kronos, the creator and devourer, brings forth Zeus whose fist concentrates the powers of nature into the instant of lightning and thunder, illuminating space. The space-forming, air-forming force breaks with increased vehemence into the outer world. Instead of warmth arise heat, pressure, suction, and light.

If the outer world consisted of nothing denser than air, the observer would still be able to perceive space. He would sense a variety of pressures in encountering the wind, as well as the configurations of the atmospheric layers and the clouds. These are impressions which provide him with a spatial picture. The inner effect of such impressions casts light into the soul life.

Light illuminates all spatial surfaces. Its pictures are shifted at the edges of the objects and are even turned upside-down by point-shaped openings. The optical properties of light are directly connected with the spatial boundaries of surface, line and point. On the borders between light and dark, red and green, one ends and the other begins. In this boundary world we find neither hard nor soft, neither red nor green, but their common germination. Light makes space visible, but does not stay within it. That was already realized by the brave citizens of legendary Schilda when they tried to catch sunshine in their bags and to carry it into their windowless town hall.

Space-creating action enters into the outer world, bringing about the airy element with its incipient surface forma-

tion. At this point the observer realizes, through his meditatively enhanced thinking, that the inner world touches the outer at each spatial boundary. The exactness of the observation shows that geometrical lines, planes, and points are *never sharp* in reality. They are zones of becoming and fading away. In order to shine, light has to come into being anew at every moment. It is of a temporal nature, a reflection coming from the outer world's boundaries.

The physiology of the senses cannot explain how external light becomes a "subjective" light sensation. Does this transition happen in the retina, along the pathways of the nervous system or only in the brain cortex? The answer lies in the living concept of time and space. The planes, lines and points of the optical phenomena are areas of constant becoming and passing. The observer's activity reaches these areas and goes beyond them into the outer world. It forms traces of warmth and air. Along this route something radiates towards the observer, showing him in a flash the shapes of all spatial objects. His space- and air-creating force meets an essentially similar force which is reflected from the surfaces of the objects. He recognizes this new entity as the reflection of the air-creating force and calls it *light*.

For a dynamic concept of light, the transformation of physical light into psychical light perception presents no problem of principle. For light is a living entity to begin with and as such does not need to be vitalized by the optic organs. The more clearly light's nature presents itself as space and air creating action radiating back into the inner world, the more perceptible its presence becomes in the realms of the body and soul. A person beams with joy when he faces the outer world harmoniously and actively. He senses the inner beaming in his imagination and emotions; it permeates his being to affect his muscular activity shaping his movements and his facial expression. The latter is physiologically a surface-bound action which calls forth movements without being a movement itself. That means it is airy in character, for the conditions of air pressure and suction at the surfaces cause physical movements without being movements themselves. Chemical investigations in the muscular physiology point towards air- and light-related processes such as the osmotic movements of tissue salts and the phosphoric metabolism. Dynamic thinking gradually leads the observer to understand how he himself creates light and air traces in his own body.

Conventional physics has described processes in which matter disappears and radiation appears in its place. Comprehension of radioactive phenomena based on a theory of knowledge has yet to be achieved. Nevertheless, natural phenomena like the air consumed by a flame, or the air generated in the leaves of plants, give us an inkling of the constant interchange of air and light: Outer and inner aspects of the forces that create space.

The Origin of Water

Warmth comes about when the outgoing force works purely in time, whereas air originates when it works into space. The moving force penetrates more deeply into the outer world than the forces formed solely in time or space. The power of thought can work beyond itself into the outer world, creating time and warmth. In a counterswing to this the thought force needs to return to its own center. It concen-

trates itself in internal overview from which it again sends its activities out into the external world, creating space and air. Over and above this, yet a further enhancement becomes possible, for it is the same life of thought that unites within itself both these creative faculties. Warmth activity is intensified to become a fiery shining, causing surfaces of tension which it dissolves only to generate them immediately anew. Through being able both to work beyond itself and to come back to the internal overview, the life of thought generates a constantly changing product in the outer world. Warmth intensified to heat, shining to glaring, air tension to thrust, result in a rolling, fiery entity. Just as movement cannot be understood as a mere combination of space and time, the new entity cannot be explained by the mere coming together of heat, air and light. The latter condense and set free an element which is even more externalized. Around the fiery process water condenses as a healing balance.

Water Flow and Linear Dimension

There is obviously a correlation between material density and spatial dimensions. Warmth has no dimension, air has one, the fluid element two, and the solid three dimensions. That could lead to the conclusion that air would form lines, and water would form surfaces. The phenomena show the opposite. Water flows in parallel lines, whether it be in the blood vessels, in rivers or in the great currents of the oceans.

The intellect is capable of connecting water with both planar and linear dimensions. A living thinking, however, tries to approach such a connection from its origin as a creative process. The latter originates in the unity of the spirit,

beginning with warmth as the least separable element. Warmth harbors an inwardly active movement which, being part of the inner world, touches the outer world without causing spatial separation. Next the element evolves which already shows separation from the originator. The outcome of the simplest form of separation between two complete entities in the outer world is a surface. We regard the formation of the unitary, but already condensed, element air. It touches the observer with gentle pressure, dissolving and re-forming from moment to moment. A first, direct encounter with the airy element consists of the perception of pressure, even before this pressure is transformed into a current of movement. Air in its formative stage *is* the touch of space creation. By its very nature, this space creation generates surfaces as well as phenomena of tension and pressure.

The inner movement that brought the outgoing force to the boundaries of space, collects itself on these boundaries in order to become immersed in space. At the surfaces of the pressure and tension phenomena the inner, purely temporal movement is transformed into outer movement. Air condenses to become water. The beginnings of space formation intensify to become movement in space. To the extent that the outer movement goes one step further into the outer world, it imprints on space a further dimension of separation in the form of lines.

Transitions of Air and Water

Two elemental conditions become perceptible: One which is alive, and in the course of becoming, and the other which is formed out and completed. Air in its living state arises on

the border between the inner and outer world as well as at the transitions of warmth and water into air. Just as the pressure in a steam engine builds up at the surface of the piston before the latter moves, it is obvious that air in a state of coming about consists of surface-like fields of tension before it starts to move.

Is air in motion already on its way to condense into water? We can reasonably expect that to be the case, after having seen how both the external movement and the watery element stem from the same inner cause. These transitions have not been much investigated so far, though chemistry differentiates traditionally between a steady compound and one that is *in statu nascendi*. Air, moving towards condensation into liquid, causes the great variety of cloud formations. The observer experiences in the tranquility of high altitude cirrus clouds a sphere where light is transformed into warmth and air, and in the moving cumulus clouds the formation of vapor with all its living shapes. The more water–saturated the clouds are, the heavier the wind often is before the rain. Air arises from the cosmic tranquility of the light and is brought into movement by heat which pushes it into further condensation.

The transition from water to air presents a different picture. Although surface cohesion is generally looked at as a property of a liquid, it presents itself to us from the concept-formation point of view as an airy phenomenon. It leads to the idea that each fluid during its formative process also acquires airy qualities to which its inner surfaces and their osmotic pressures belong. Is the strong surface cohesion of quicksilver a result of its material cohesion? Conventional physics considers cohesion to be solely the effect of molecular attraction ("Van der Waal's forces"). Goetheanistic physics is more interested in qualitative observation. If the surface tension of water is quantitatively reduced, e.g. by the addition of soap, the richness of the surface phenomena is increased and their relationship to the air becomes more visible in the formation of foam.

Movement Characteristics of Water and Air

Movement likes to traverse space, curl up surfaces into whirls and to pull them into formed lines. Water flows in lines. It tries to straighten out any irregularities along its flow into linear forms. If its movements are made visible, they reveal their parallel flows, even if they roll up into the parallel layers of a whirl. Geometrically, we have to consider these forms as line formations, although they appear to be planes, because all the flow lines run parallel to one another. We recognize in the water flow the laws of field separation (page 63).

In accordance with its elementary characteristics, air moves differently from water. It is constantly contracting and expanding under its changing pressure conditions. Fields of pressure and suction alternate in the flow of air. In the way a leaf does not fall down evenly, but swings back and forth through the air, the surface-forming process in the movement of air becomes visible. The dynamic interplay of surfaces of pressure and suction generates concave forms. These take the shape of waves in any wind-blown water surface. Waves rush over the water independently of the water flow, and they will readily respond to the slightest breeze. Geometrically, the so-called transversal wave undulates vertically to the direction of its movement. The wave form connects at

any given moment the direction of locomotion with the vertical direction of the undulation. It is a result of the field extension (page 65).

The Dematerializing of Water

When creative power works through movement into the outer world, water comes about. That would mean that every human being in moving could generate water out of nothing. Water would not only be freed up by processes of oxidation such as the "burning of carbohydrates", but it would be generated out of the physical nothing. We imagine that a vital force takes hold of the fluids in our body and moves them around. The mental picture of a fried chicken is supposed to stimulate the secretion of the digestive juices via the nervous system. Our usual thinking remains mechanistic. It understands only lifeless water pushed along by an outside force, but not the water-creating unity of life and movement. If living spiritual force makes contact with the fluid element, takes hold of it and brings it into movement, then there has to be a point of leverage where like meets like. The forces coming from the inner world extend to the region where they condense into external effects.

As water is created out of the inner world, it must also be able to return whence it came. It does not only undergo chemical changes, but it is dematerialized. The water-forming force also has the power to cause water to cease to exist. If the human soul resembles water, then water also resembles the soul in its "eternal alternation" (Goethe) between heaven and earth. In generating warmth, the connection between willful activity and external phenomenon could still be realized, but we usually find it impossible to create or destroy water at will, although watery processes such as the blood circulation or the excretion of body fluids are closely connected with our soul life. Our investigation must be based only on perceptible and knowable outer phenomena and on clear thinking. Nevertheless, we work on the premise of meditatively enhanced thinking.

The key to the solution of the problem lies in the insight that the force of living thought bears within itself a power which we can realize only to the smallest extent. By virtue of its inner movement, it reaches out beyond itself to bring about moving effects in the outer world. It moves, shapes, and forms the liquid element. To be able to perceive the latter, however, thinking has to hold its activity back so as not to alter what is perceived. The observer creates within his own activity a hollow inner space of nonactivity. At the moment that water is perceived, this encounters the observer's self. What is physically external meets the mind, i.e. unlike encounters unlike. One is compelled to destroy the other. The thought force, identical with the observer's self, tolerates the water perception only for an instant before digesting it by means of its own water-creating forces. It transfers the perception into the inner world. The water formation works this time in the opposite direction, that is, as assimilation towards the spiritual center, as a kind of spiritual thirst. It is a much more intensive countermovement than is the inner light formation. Not only does an inner space become illuminated, but the flow enters into the inner life. We call this *inner sound*.

Sound Formation and Acoustic Waves

Sounds, noises, roars, etc. are in all cases bound up with the perception of movement. Music enters more deeply into the soul life than do images from the element of light. Sounds are, like warmth and light, time-related phenomena. Inner warming activity remains in the realm of time although it touches the outer world. Intensified to light, such activity adds to external space a bright temporal one. In the sphere of sound the realm of time finds a further enhancement into movement. — Conventional physicists cannot understand the realm of time because they lack a concept of what time is. They try to overcome contradictions by acknowledging only the spatial substrate of sound as real. They pronounce tones to be unreal, and equate them with acoustic waves. Physics arbitrarily excludes direct tone perception from its system and thus falls into basic error. Acoustic waves are not identical with tones. The former consist of undulations with geometrically measurable distances. Tones on the other hand are no more measurable geometrically than any other process in time; they are phenomena which in moving from the outer to the inner world cross the realm of time. They leave the waves behind them as external traces.

The example of the acoustic waves may illustrate that the formation of both water and sound are akin; but acoustic waves are only sound's external traces. The dense medium vibrates *in the direction* in which the acoustic wave travels. That is, the acoustic wave proceeds only in linear fashion, "longitudinally." We found the same principle of linear movement, of field separation, earlier on in the shapes formed by flowing water (page 137).

Sound Formation and Hollow Forms

How can we reconcile the principle of field separation with the fact that sound likes the cavities of resonant bodies? The cavities in resonant bodies are not simple hollow forms in the sense of field extension (page 65). The latter forms arch themselves into the denser matter. They avoid the center point because they stretch inwards from the periphery to which they belong. The cavity of an air bubble in water, or that inside an organ pipe, proceeds one step further as it separates itself from the periphery by forming circles in one or more planes. The subtle peripheral element is taken into the denser, center-forming element: What has been encapsulated within the condensed element wants to return to the periphery.

Nature offers similar formations and transformations in all transitions. In the plant world we find the hyperbolic and spiral forms being created out of a periphery of air and light. In the evolution of the vertebrates it is, initially, the completion of their organisms within the water that produces the linear and spherical shapes of the fish world. The life of the amphibia, which at first has to complete its own organisms within the watery element, opens up again to the elements of the periphery. It pokes its eyes and nostrils through the water's surface, fills its lungs with air, and sounds forth. The word "croak" cannot describe the jubilation of American chorus frogs in spring, or the summer concert of tree and bull frogs. The force going outward in movement discovers its inner life more than before and carries it into the denseness of the watery element. From there it brings it back into the spiritual world as the inner experience of sound.

A glimpse into the secret of this returning transformation may be discerned in the human ear: The musical shape of its lobe, the sound resonance in the tunnel of the ear canal; then, as a barrier to the outside, the vibrating ear drum, still surrounded by air; the small acoustic bones, like minuscule limbs leading towards the inner ear; the inner ear embedded in the depths of the petrous bone, a labyrinth filled with water. What goes on inside the very fine geometrical shapes of the spiral organ and acoustic nerve? It gives us roughly as much information about sound perception as does an airport runway about an airplane's flight. The transformation of acoustic waves into the tones we hear is an unsolvable riddle for mechanistic thinking. That is because whatever happens in the vibrations and movements of the exo- and endolymph in the inner ear is permeated by the activity of the one who hears. We cause the flowing and sounding in our ear, but we have to hold back our activity in order to hear. We participate in nature's creation through our insight and actions. Such activity extends beyond itself in the creation of elemental substance. In dissolving the shapes it brought forth, the activity experiences itself.

The Formation of Organisms and Solidification

Physics relies on the phenomenology of solids more than on those of other elements. It needs durable parts and rigid shapes to establish mathematical and geometrical correlations. Without the solidity of contours the surrounding world, as well as our consciousness, would be blurred. Leaving the water and stepping on to solid earth is seen from different perspectives as being crucial for human evolution:

For Darwinists it is the formation of the higher animal species; anthroposophical spiritual science sees it as the change in the earth's watery and airy condition of previous evolutionary stages into a drier, more solid, structure. This took place after the Atlantic flood and was bound up with the development of human thinking. Such a transition from a watery into an airy, and solid, milieu has its archetype in childbirth. The "hard facts" confront us with the pain of collision and separation, but also with the joy of freedom and mastership. Solid substance is experienced as a state of final density, of completion and death. For a physics that confines itself to what is lifeless, nothing exists but the solid. Fluids and gases are defined as compositions of particles with solid features. Even the various forms of "energy" are supposed to be composed of particles (quantums).

However imperfectly the attempt may work out, it is necessary, when we consider the solid element, to establish the connection between the creating force and the created object. Everyone has the experience of being creative. The physicist may suppress this experience or admit that each scientific insight calls for a creative act of thought. Insight into the creative power of thought carries within itself the capability for its own methodical enhancement. Living thinking leads the concept of the watery element one final step further into external density. In the case of liquids, the mobility of thinking, weaving back and forth between *working beyond itself* and *overview*, leads to immersion in the outer world. To become solid a further stage of intensity is needed. Working beyond itself is for abstract thinking already an unimaginable concept. Only to the meditatively trained thought is the insight accessible that thought power, initially unformed, can work

beyond its own inner life and generate warmth. What happens there sequentially is welded together by the uniting activity of thought into space-forming cooperation and is carried still further into the outer world. The same thought life is capable of working beyond itself, of becoming centered in insight *and* capable of enhancing these two activities into movement. Movement is the higher origin of the creation of space and time, weaving both into a unity. Movement, however, is not the highest element-creating thought force, since it is oriented towards the production of spatial and temporal activities. It is directly fettered to its links with space and time, and unable to free itself from them.

Within the thought movement a deeper spiritual layer becomes visible: The life of thought itself. This thought life brings about movement as well as the formation of space and time, even though it is itself more than each aspect of its activity. It imparts some of its innermost being to each of its creations. The formation of warmth in time, of air in space and of water in movement is therefore due to a creative force which exceeds all others. It draws the elements, as they arise, towards each other. Water is permeated by air, light and warmth. The elements combine in a new entity. It is important to grasp that, whereas each element arises in its own way, all of them are permeated by the life they have in common. The result can only be an organism. What is spiritually common to all creative powers causes the rounding off into organic unity, an image of the inner world in the elementary outer world. Warmth, air, and water lose their independence. They are subject to a formative force which gives them their final external completion. The last step outwards into the external world has its origin in the highest life of thought. The

rounding off forces envelop the organism with the solid element.

The technical form of the elements is much less useful for our investigations than, for instance, the warmth of a handshake, the air we breathe, the flow of the fluids in tissues and blood vessels, or the solidity of a sea shell. An organic process always allows us to sense the inner activity from which the elements have arisen. In their state of becoming these are alive and tend to form organisms. At the moment they enter the outer world, the elements become subject to death. The organism tries through the formation of an external skin or even a hard shell to preserve its life, and to ward off the effects of lifelessness.

Organic Language

We call the ability of our life of thinking to outwardly create, to warm through, to penetrate with air and finally to form solidity, the capacity to *organize*. Wherever the highest form of thought life encounters the outer world, organisms arise. Warmth, air, fluidity and solidity behave as one entity since they are permeated by their common life. An intensification of body heat, whether caused by a febrile temperature increase, or by hot compresses, leads to alterations in the transfer of air and in the circulation and excretions of body fluids. Each organism, down to the unicellular level, *responds* to an external stimulus in varied ways. This ability to respond can be called *organic language*. The life of thought is able to create all the elements, to change them into one another and to bring them into interaction. This leads to a diversity of elementary forms of expression which manifests

itself as a language of its own. To this belong the differences in appearance between a dehydrated, undernourished, and a well-kept plant, and even the overall behavior of any physiological process.

Just as with the other elements, the outgoing and the returning pathways become visible at this last externalization stage. The life of thinking comes into contact with the outer world in the course of the organization that leads towards solidity. But it also has the power to recover again what it has created. Solidity is dissolved; a disintegrating force takes hold of the organism and decomposes it. In this way the organizing activity, which generates the solid, is set free to return from the outer world into the spiritual domain. What had emanated as activity from the thought life now returns as *language*.

The fact that the dissolution of what was solid is connected with the appearance of language may not be immediately convincing. We can expect little agreement from conventional physics because it acknowledges neither the concept of life nor that of the transformation of the physical back into the spiritual. We have, therefore, to rely entirely on the Goetheanistic view of nature. As elements are dissolved, element-creating powers are set free. Light and sound are not external waves but activities which come towards the observer from outside. Light can be considered as a returning space-creating force; sound can be imagined as light that has been turned inwards, a returning movement. Viewed in this way, language manifests itself as sound that has been internalized even by one further step.

Friedrich von Hardenberg
Novalis
1772-1801

NOVALIS, the Poet of the Blue Flower was known only to a small circle of German early Romantics during his lifetime. His literary work was accomplished in the short period of his last three years, overshadowed by his mourning over the death of his fiancée, Sophie von Kühn. His friend, Ludwig Tieck, wrote in the preface to Novalis' collected works, "Many of his great thoughts will inspire others in the future, and noble minds and serious thinkers will be enlightened and fired up by the flashes of his spirit." But the writings of the young poet encountered little interest until the beginning of this century. Minor's edition (1907) and that of Kluckhohn (1928) presented his complete works for the first time, within which a collection of about 3000 fragments emerges. In his poetry Novalis had portrayed in the finest outlines an image of nature and man permeated by spirit; but in the fragments he had extended this image to take in all the details of the cosmos and the human soul. Two centuries later we discern in his

writings the shape of a powerful synopsis of the sciences that leads into the future. The miracle of the three productive poetry years is emphasized by the fact that Novalis had at the same time been completing his training at the Freiberg mining academy and had taken on duties in 1799 as inspector of various mines in the Electorate of Saxony.

Novalis was brought up in the spirit of the Herrenhut Community. During his academic training, partly under the influence of Herder and Lavater, he had studied "Theosophy and Alchemy". His body of thought, however, cannot be grouped into any contemporary religious or philosophical system. He recognized the importance of Goethe's scientific writings as soon as they were published and his own genius led him to strive for the implementation of Goethe's method in the natural sciences.

Descriptions of the language of Nature are to be found much more readily in poetry than in scientific papers. Novalis' works contain depictions of genius which are timeless and deserve our closest attention. In *The Apprentices of Sais* Novalis described the education of a scientist as an initiation. The apprentice, on his own individual path, has to acquire a sense for nature through training his powers of observation. Then he will be able to decipher the secret script which one "can perceive in wings, egg-shells, clouds, snow, in crystals and rock formations, in icy surfaces, in the inner and outer shapes of mountains, in plants, animals, and humans, in the lights of the sky, in fragments of pitch and glass when they are touched or stroked, in iron filings around a magnet, and in the strange coincidences of chance." The script of nature reveals the creative language of living thinking which also works as a spiritual power in human destinies.

In his *Fragments* Novalis outlined his vision of a science of life. He demanded of a physicist conducting experiments an artistic gift of observation and an ability to work out of the spirit of Nature. The "holy path" leads to an inkling of the point of contact with the invisible world from which life emanates. The true path of the physicist is not to explain the whole from its separated parts, but vice versa. "The first chapter of physics belongs to the world of spirit."

Novalis foresaw in detail that natural processes, as understood by a "future physics", work in exactly the opposite way to what is taught by particle-oriented physics. He saw life as an observable phenomenon, comparable with the phenomena of colors, musical tones or mechanical force. A scien-

tist who observes the life within thinking is able to perceive the creative side of the physical elements. Novalis described light as a living process, fire as "the thought force of nature" and as generating water. Everything physical, even gravity, originated in the spiritual world. Nature will pass away one day and be transformed back again into spirit.

Novalis had in mind a project for a "Goethean approach to the sciences". He recognized the need for thinking to be further developed so as to overcome the fragmentation of the sciences, including physics. He called this the "poetizing" of the sciences. For him this meant an enhanced, creative way of thinking which would lead towards morality. It was not given to Novalis to complete even a part of his plan. His *Fragments* are "flower dust" that he scattered over all areas of human thinking. They are a book of thought training needed for the renewal of physics and the other sciences.

The Formation of Solidity

Spiritual activity works furthest beyond itself when it forms solidity. The external product becomes completely separated from the activity that originated it. Warmth makes no boundaries between an inner and outer world; in the aeriform such a border consists of the volatile beginnings of surfaces. These elements are permeated by the activities of their origin without becoming completely separated. The watery element contains inner surfaces which it brings into flowing linear interaction. The solid element, however, is the result of the final separation of life forces from their outer effects. The flow of the lines has to solidify in order to delineate their intersections. It is here that the final separation between living action and outer effect is accomplished. Organizing, which is the most thorough formation process and the one that reaches furthest into the outer world, also withdraws with thorough completeness from its product. The last possible separation results geometrically in the point.

What seems to abstract knowledge to be the simplest, i.e. the point, is the most complicated as far as the process of creation is concerned. This is because spiritual creation, derived from unity, advances step by step into the world of separation. Since warmth is an indivisible unity, it still lacks a spatial dimension. The dimension formed by air gives rise to the first separation within the unity. But these are only the incomplete beginnings of surfaces without lines or their intersections. For the first time the watery element forms lines but not yet points. It is two-dimensional because it also contains a legacy from the airy formation. Here we can perceive how the formation of a crystal contains the legacies of the other elements, e.g. edges from the liquid, surfaces from the aeriform, and spatial unity from the warmth element.

The living organizing force generates burgeoning and vanishing points as it reaches out, grasps and retreats. As it withdraws, it leaves behind solid traces. As each withdrawal results in a new outreach, solid structures are once more reenlivened. The firm, constantly renewing shape, say, of a unicellular organism is brought about. We know, from zoology, about the ameba, and slugs, etc., whose bodies are kept soft, in contrast to organisms which develop shells and skeletons. The latter are more highly developed as they have to counterbalance the dying skeleton by an even stronger life system. Biology does not only describe the world of silica-forming diatomeas and limestone-producing molluscs, the

sedimentations of which resulted in geological formations and mountains, but we also learn about primitive forms of life, such as viruses which are capable of temporary crystallization. Facts like these, that lie within the scope of today's scientific observation, suggest that in earlier stages of earth evolution the whole mineral kingdom was not merely liquid but actually alive as well.

The extent to which the organizing power of thought is able to generate and change traces of solid matter in our bodies will be the subject of a physiology of the future. Conscious human thinking is far too weak to produce either organisms or solid matter. But we can find a comparable process in the social sphere. A business corporation or a community has an organic structure, be it in the way its components work together internally or in its relations with the social environment. Here, too, numbers are important. The social form has a tendency to move into the solid structure of a house. — The comparison may suggest in what way the ideas of social life already contain the intuitive quality of thinking needed in organic physics.

Perception of Solids

Solid objects are often viewed as trivial things, and their existence is taken for granted. They are "what you can see and touch" and they belong to the usual "world of the senses". Their perceptibility and their reality, however, are inescapable problems for any philosophy. Does an observer see any more than the light effects reflected from an object's surface, or must he conclude from the light that there is an object reflecting it? He can touch a solid body even when it is

not illuminated. Does he then perceive the object itself or only the sensations of his own skin, the resistance to his muscular movements and similar bodily processes?

Light and color appear as outer impressions, in which the observer discerns the activity of space formation (page 131). Each degree of color's darkness is an outer perception as is light itself. In "nonlight" light's life which, as the messenger of the outer world shines into the inner world, is missing. To reach out by means of cognition into the outer world where the light is refracted, reflected, and absorbed, the observer pursues the light up to the point where it turns into darkness. His space-forming activity reaches up to its boundary with the outer world where it comes to an end. It holds itself back there and awaits impressions. It finds darkness but tactile impressions as well.

Let us closely examine the tactile impressions, including those of air resistance. They are messengers from the outer world just as the visual impressions are. "Something" comes from a realm out there where I am not active. These impressions are followed by sensations of pressure on the skin, tensions in the muscles and other processes which extend from outside into the sphere where I am active. But I have to go beyond my own activity to reach outer reality. Everything which is sensation I have to pursue up to the boundary where it turns into its own absence. This transition is in itself an external perception. Only where the transition occurs is the external perceived.

One of Novalis' Fragments points memorably to this boundary: "Everything visible is attached to the invisible — the audible to the inaudible — the tangible to the intangible, maybe the thinkable to the unthinkable." Did he mean the

transition of the searching, sensory consciousness over into the supersensible, or also the transition sought by meditative consciousness towards the reality of the outer world?

The perception of the fluid element reaches the observer as a rushing and roaring more at a distance, and as a vibrating contact with the skin as an immediate sensation. These are impressions which set off activities of movement and flow in the observer. In perceiving these activities, clarified and enhanced by his living thinking, he will recognize the concept of water formation. However, in order to come to the outer reality of water he needs to pursue his hearing and touch impressions, as well as his own conceptual activity, right up to their outer boundaries. The boundary between the inner and outer world is one of time. In the formation of water the temporal boundary is dynamically immersed into that space where surfaces start to enclose an inner space. The composition of forms which in the aeriform element were only the beginnings of surfaces, will be enhanced in the watery element towards line formation. The perception of fluids takes place along a border between the inner and the outer world that is moving lineally.

Only with the perception of solids does this border become firm and sharp. Surfaces crystallize into planes, forming intersections *and* points with one another, thus achieving completion in space. This completion may be experienced by touching a solid object. Whatever the sensation of touch may be intrinsically, it is followed to the point where it ceases. It is only when these sensory boundaries are encountered that the solid external shapes are perceived.

What does our sensation of touch consist of? It is dull, compared with our sensations of warmth, light or sound.

Helen Keller movingly describes in her autobiography how by itself the sense of touch may convey a world that is filled with warmth, light and sound. The high point in her world of touch was the perception of speech. When we touch something we are affected by an element which is akin to warmth, light and sound, something that is unformed though even more alive. We discern in it the conceptual activity of organizing (page 144). A content, coming from outside, touches us, and proves similar to the activity that works creatively from the center of our thought life. Helen Keller was so alert in her touch perception that she was able to experience its inner language.

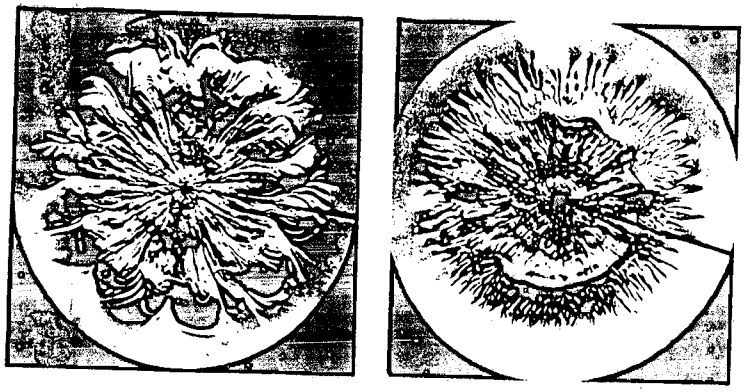
Samuel Hahnemann
1755-1843

SAMUEL HAHNEMANN came from an artist family in the Saxon porcelain town of Meissen. His parental home was remarkable for its protestant piety. — As a medical student he has to work hard to earn his living. Just before the end of his training, he meets in Vienna Baron von Bruckenthal, a wealthy Freemason, who hires him as family physician and librarian. Hahnemann becomes a member of the lodge (in later years he renews his Freemasonry membership). He finishes his medical training in 1779 in Erlangen. In 1782 the young doctor marries a pharmacist's daughter. In the subsequent years of constant relocations the growing family accompanies him. Under the most difficult conditions Hahnemann with his wife, children and their belongings move year after year from one place to another. Often his moves are caused by enmity on the part of physicians whom he has challenged. This is a family where poverty is a guest. Is it an aimless odyssey which at first leads him westwards, bypassing Jena and Weimar, and then on to the north, to Hamburg and Moelln? Halfway through these fourteen years of change, Hahnemann's epoch-making principle is publicized: "Each true remedy causes in the human body

a kind of illness of its own. Imitate Nature as it sometimes heals one chronic illness through a new one, and apply in the (preferably chronic) illness the remedy capable to excite an artificial illness as similar as possible to the first one, and the first illness will be cured; similia similibus." — Several years after settling down again in Saxony, the master succeeds in summarizing the new method of healing in his book "Organon".

Hahnemann's last years were as unusual as his earlier life. He remarried in old age, then moved to Paris where the great loner immediately found himself in the center of European cultural society, untiringly curing crowds of patients. Karl König has pointed to Hahnemann's connection with the Celtic spiritual stream which fatefully led the healer into the land of the druids. Did the same destiny draw him, at the inspired turning point halfway through his life, towards the landscapes of the Externsteine and the megalithic graves near Hamburg?

Hahnemann had an artist's imagination and was at the same time a meticulous observer. "Pure experience" was for him the unity of both sensory and spiritual perception. He observed the totality of the outer symptoms and recognized within them the spiritual nature of the illness. He found the healing counterpart to the illnesses in the inner "remedial nature" of substances. Hahnemann saw true healing power in the spirituality of nature. For Hahnemann it would be as foolish to ignore the "life-sustaining force", and the immaterial "remedial force", as to deny the existence of an individuality behind the gestures of a human body. His scientific thinking was deeply humane. He warned against the inhuman treatment of illnesses to which a materialistic medicine would lead. Homeopathy was not only the beginning of a new art of healing but also the exposition of a spiritual concept of substance and matter. In the year which saw the publication of Goethe's "Theory of Color" and Hahnemann's "Organon", the path of natural science divided. Creative thinking confronted scientific materialism.



Drop-Picture Method by Theodor Schwenk

Institut für Strömungswissenschaften,
Herrischried/Schwarzwald, Germany

The above "drop-pictures" belong to a series done by Theodor Schwenk, who had first published this method in 1967. Drop-pictures are obtained when distilled water is allowed to drop into the glass dish containing the tested watery solution; the latter is optically densified by addition of glycerin.

Left picture: Specimen of a Black Forest spring; normal, harmoniously and strongly shaped formation. Right picture: City drinking water; reduced, partly irregularly dense, partly uneven-radial formation. (Published 1971 in "Evolution und Heilmittel", Weleda A.G., Arlesheim, Switzerland and Schwäbisch Gmünd, Germany)

Discovered by Theodor Schwenk, this method has proved to be a unique test for the quality of drinking water. A wide range of drop picture research is done at the *Institut für Strömungswissenschaften* and at other laboratories. It illuminates the understanding of water as a living entity, sensitive to the influences of time rhythms of nature and even of planetary constellations, but vulnerable to technology.

AN ORGANIC CONCEPT OF FORCE

Elemental Life

Conventional biology applies the concept of "life" to organisms consisting of cells. Is it only the cellular protein that is alive while the salts which are dissolved in the cellular protein are already dead? If a whole frog is alive, is it then not true, for instance, that its digestive enzymes are alive too? Organic life points beyond the boundaries of the single organism to the elemental life of the whole earth organism. A consistent science of nature cannot avoid recognizing the living quality of the natural elemental forms of warmth, air, water, light, etc. The difference between living and lifeless water has been thoroughly documented by means of Theodor Schwenk's drop-picture method. The fact that natural substances contain elemental life, which can be set free and enhanced to become remedies, is demonstrated by homeopathic medicine. The effects of homeopathic remedies contradict the concepts of conventional physics, which holds that a preparation potentized beyond the 23rd decimal dilution cannot retain any of the original substance's effect. Hahnemann had a clear understanding of the underlying life forces, whose non-material, spiritual properties he extensively described.

Leads to an out-of-body spiritual life have been pursued by scientific research in the last decades, notably in the documentations of Raymond Moody and others. People who have been close to death describe an experience out of the body in which they were still fully conscious of themselves. Such a form of existence was known to the mystics of all ages. Rudolf Steiner succeeded, toward the end of the last century, in developing a research method that is based on the existence of the spirit. He discerned pure thought to be the center of non-material experience and described the path on which this can be developed out of everyday thinking.

Thinking is concept-forming inner activity. Just as, for instance, the concept of a door is one, eternal, transparent and valid beyond the individual person, this also holds true for the faculty of thinking itself. It consists both of consciousness of the self and the insight into a world-wide entity. It is forcefully active but consciously sensitive, too. It perceives contents which differ from itself and acts upon them. The world has been created out of spiritual activity. If we were to develop and intensify our thinking to the utmost possible extent, we would still only be able to grasp a tiny fragment of the force involved in the formation of the elements. We experience in thought the fullness of truth as well as nature-creating reality, even if only in a very modest sample. We strive towards an inkling in Novalis' sense, working out of clear thinking but being aware of the minuteness of individual cognition.

Mechanical Forces

A billiard ball strikes another lying on the pool table and comes to rest at the point and moment of collision, while the ball struck rolls off in the same direction and with the same speed as the first ball. The player had struck the first ball skilfully. Two watching physicists are more absorbed in the mechanical properties of the balls than in the progress of the game. What is transferred from the moving ball to the stationary one? Does the "force" permeate the moving ball and then jump through the point of collision into the second ball? What does the "force" look like at the moment it separates from the first ball and crosses over into the second? If this force is considered to be weightless, dimensionless and immaterial, is it then anything more than a physical nothing?

The conventional physicist would dearly like to abandon the concept of force, but he can not really do without it. He needs Newton's concept of force to define energy (force x distance) and momentum (force x time). He recalls the words of a physics professor: "Perhaps the most important, the most relevant to our later study of physics, are the concepts of energy and momentum and their conservation laws." "Newton had based his laws on the forces between objects and the accelerations those forces produced, but ... the energy and momentum methods allow us to solve problems without using forces and consequently provide an alternative to the force concept."

Although the physicist may be unable to imagine what external force actually is, he still can predict that the momentum of a billiard ball has exactly the power to transmit its speed to a ball of equal size. The same impact is transmitted

from one ball to the next. In a world of balls the impact g
"never lost". But the effect of friction on impact causes t
next sphere to roll on with slightly diminished speed. Th
difference is explained by the mechanical theory of he
Heat in its different degrees is assumed to consist of the m
tion of particles constantly bouncing against each other,
our case the momentum applied to the friction of the tw
billiard balls being transmitted to these particles. — At th
point the second of the two physicists, who follows th
Goetheanistic method, has to object: Where, in this world o
balls and particles, is the heat radiation produced at eac
collision to be found? Does it not escape into space like th
light, eluding any means of observation? The law of conser
vation of total momentum in the cosmos is for the Goethean
ist an unverifiable assertion. He concludes that the tru
nature of mechanical force will remain hidden for as long a
the momentum of the balls is dealt with independently of th
billiard player. He tries to understand the process from
different point of view.

The process starts with the player's thinking, in his inten
tions, and in his concentration. The thinking, intensified
through meditation, pursues the transition from thought
force into external warmth. Heat formation, muscle tension,
and arm movement are physiological stages in the transition
from mental to bodily movement. The answer to the ques
tion, how mechanical forces affect a body and connect with it
to generate its momentum, is in the first place given by the
element of warmth. Warmth is the result of outgoing force. It
extends to the outer world even though it does not tend by
its own nature to become dense, staying rather in the region
of becoming and fading away. Warmth is full of inner motion

and would like to lift solid matter out of its spatial rigidity into movement's arising and vanishing. This happens immediately in the expansion of a heated body. A direct comparison between heat and moving force, however, would resemble a steam engine with no steam in its boiler. Its frame would expand due to the heat, but it would not move. A transition, such as that generated by the pressure of the heated steam, is needed. It is only due to steam pressure on the piston that the power is transformed into a linear movement and transmitted to the wheels.

The spheres' mechanical force of motion proves to be in its characteristics much closer to the watery element than to the solid. Place a few equal-sized glass balls onto a smooth surface in a line with small distances between them. A similar ball, rolling in the same direction, hits the first ball and transmits its motion to it, and to the other balls in succession. The motive force, and its impact, works its way through the line of balls like a swimmer through water. It displays the features of flowing movement.

The insight given by intensified thinking into the creation of the airy and fluid elements gives us further leads. Air, in the state of becoming, is an entity permeated by the living forces of pressure and suction. Once it arrives in the external world, the entity disintegrates, especially when drawn into technological processes. Life withdraws, and the air densifies and joins the world of spatial bodies. But it still shows characteristics of the living forces from which it arose. Pressure and suction forces imitate the formation of air without, however, being able to generate new air. They continue on their own in the outer world transmitting their effects to denser objects, such as an airplane's wings where they cause strong

upward suction. Mechanical forces are externalized models of element-forming living forces.

The same holds true for the fluid element. Wherever it is present in nature, it contains life. It flows and lives in unity. Its living forces of movement are the creative concept of water itself. In rhythms of the ocean's waves and currents, life, water and its forces of movement are a unity, which is made visible in phenomena such as the pulsations of a jelly fish. This unity breaks up in the surf, in splashing against a stone wall, or even more, with water's technological utilization. The life of water is extinguished. The forces of movement are mechanically reflected. They continue way beyond the water, destroying, for example, a sand castle on the beach. The water-creating forces, that withdraw, leave their mark behind as a movement impulse, as an outer imitation of a living activity.

This view highlights some features of the force of movement, a force that combines spatially with the moving sphere, then leaves it behind in order to jump to the next sphere. A spatial entity disappears up to a boundary so as to reappear spatially beyond it. We recognize here the prime phenomenon of movement as was demonstrated with the example of the moving train (page 95). Force of movement seizes what is spatial and brings it into temporal flow in change and formation. At the instant when it leaps over from one ball to the next, the mechanical force of movement exists without any spatial extension. It has left external space and has become purely temporal. The phenomena indicate that mechanical forces are really at home in the realm of time. According to their own nature they link themselves with spatial bodies but return again and again to their temporal form.

This corresponds to the temporal appearance of warmth, except that the forces of tension and movement enter more deeply into the spatial structures of the elements.

The various external forces are by their very nature interconnected. Being extensions of element-forming activity, they tend to work outwards as far as the realm of the solid and, conversely, to change back into states lying closer to the inner world. The organic physicist considers the mutual transitions of forces between heat, tension and movement to be metamorphoses in the Goethean sense. He understands the sequence in which a seed capsule dries out in the sun, pops open, and scatters the seed to be partly a mechanical but also a living process. The forces of heat and movement, etc., transmute into one another in an exact balance for as long as they are part of the external world. That does not prevent them, however, from having their origin in the inner world and being reassimilated into it.

Is Energy Perpetual?

The principle of the Conservation of Energy was already inherent in Galileo's and Newton's thinking before it was formulated. Even if it was impossible to invent a perpetuum mobile machine, the whole cosmos was viewed as a self-perpetuating mechanism. This had to work with the precision of a pendulum in which potential and kinetic energies were continually transformed alternately into one another. When, around 1840, the physician Julius Robert Mayer discovered the transmutability of heat and kinetic energy, the sciences, medicine included, were already dominated by mechanistic thinking. It was believed that the future would provide all

the discoveries necessary for the final confirmation of the mechanistic theory of the world. It was in this sense that the energy principle was proclaimed by the physiologist Hermann von Helmholtz in 1847. Since then it has been accepted as one of the basic principles of physics. "When all forms of possible energy are considered, it becomes evident that the energy principle is a general law of nature. In no natural process is energy lost or is energy generated out of nothing ... It follows from this that the total amount of energy in the cosmos is constant." (W. Westphal, Physics, 1950). "The law of conservation of energy is probably the most fundamental of all the generalizations made by scientists and the one they would be most reluctant to discard." (Isaac Asimov, Understanding Physics, 1969).

Newton's force concept continues to have its place in the system of physical laws. However, physicists hesitate to mention force because it cannot anywhere be seen. Nowadays, there is more mention of "energy". With the "fundamental generalization" of the energy principle physicists find themselves in the uncomfortable situation of giving a more general meaning to a derived entity, force multiplied by distance, than to the original entity of force itself.

From the viewpoint of living thinking the energy principle is untenable. The convertibility of mechanical energy, heat, radiation energy, etc., between themselves disproves, rather than proves, the law of the conservation of energy. There can be no perpetuum mobile because heat is "lost" with every energy transformation. The cosmos is assumed to be a perpetuum mobile because the lost heat is supposedly stored somewhere in the "All". The energy principle thus remains unverifiable. If energy can be neither added nor removed from the physical world, no creative deed exists. The energy principle contradicts not only every religion but is also incompatible with basic jurisprudence. A judge considers the accused to be the originator of an event. In order to carry out his intention, the person responsible has to cause a change in his body's energy system. How could this happen if he, himself, could not generate new energy within his body?

Living thinking is able to perceive its own ability to put into the outer world such effects as force, energy, or warmth. These effects are generated out of physical nothing. Warmth is created by active immersion into the outer world. It becomes also an experience of inner warmth, and its action then returns to the observer. When it is perceived, warmth is taken back into the inner world in order to be digested. At the same time heat "energy" disappears from the outer world.

Gravity and Solidity

Gravity, more than all other forces, is a still unsolved riddle for modern physics. So far, all attempts to reconcile the theories underlying the gravitational and electromagnetic fields have been in vain. Gravity travels neither as a "wave" nor as a "particle". Einstein therefore defined gravity as space, and space as gravity, which would render any propagation of gravity unnecessary. Gravity fails equally to fit into the energy model. Although physically considered to be a force, gravity does not provide energy. It corresponds more

to negative energy, the logical pursuit of which has led to the strange theories of "black holes".

Seen from a spiritual viewpoint, gravity owes its origin to a spiritually creative force. How are forces which are so basically different related to each other? Even if we were able to form an inkling of warmth's inner origin and of the forces of tension and motion, we would still be unable to find a bridge from the realm of inner forces to gravity. The researcher would have to die and turn into stone in order to bring forth gravity.

Unlike other forces, gravity cannot be transferred from one object to another, being inflexibly connected to its object. It seems to bring about movement but, in reality, it merely reverses the work of the other forces. It acts on mobile objects; but all its movements are brought to a final resting point. It is fixed in each body's center of gravity. Gravity, both through its effects as well as through its geometrical structure, is point-oriented. In its rigidity it belongs to the solid element. Unlike the other elemental forces it does not grasp objects from outside but works outwards from the object's center.

In the organic realm a forming of centers takes place which is both interesting and relevant. This is the temporal-spatial rhythm of contraction and expansion which is particularly clear in the plant world, though it belongs to the morphology of all organisms. The life processes are centered in the nucleus of the living cell. They separate themselves from the world around by means of a semi-solid cell membrane, assimilating and excreting. The forms of plants, animals or human beings are defined by their skins. Any of these organisms unites temperature rhythms, the aeriform

processes of pressure and suction, and the liquid flow into one entity. What force lifts the elements out of their surroundings and molds them into *one* form in time and space? It can only be a living force which is at home with these elements but of a higher order. The creative spiritual force, which generated warmth in its formless state and took on aeriform and liquid shapes, achieves its full intensity as it brings forth actions from its very center. The innermost spiritual force does not give its core away to the outer world; this stays within itself. Nevertheless, it imparts its own life to all elements as they come into being. It is to this force that the elements owe the mutual affinity that binds them together in an organism. *Organizing* (page 144) is the highest enhancement of the element-creating force. It is the enhancement which emanates from the very center of the spiritual force. The part of it that reaches the outer world forms living centers, organisms. The organizing force brings the elements into their final shape and at the same time creates the first beginnings of solidity. As perfect as the life process is, as complete is also its separation from its external product. What had become solid dies; a remnant of the center-forming force through which the solid came into existence, gravitational force, remains with it.

Gravity is the counterpart of the organizing life forces. These condense living flux into semisolid protoplasm. Life forces shaped out of the center of thinking create external centers within the boundaries of all organisms; in the microscopic realm they form each cell's nucleus. We find these centers in the germination and sprouting of seeds, buds and spores. Each growth not only overcomes gravity but often extraordinary mechanical obstacles. However, it also gener-

ates gravity. It creates solid matter and releases it from its life process. At the moment when the life forces withdraw from the solid, they leave their negative counterimage behind. The object drops out of the life process. The counterpart of the life force stays connected with the solid object and draws it towards other lifeless bodies. The power of earthly gravity cannot be contained in an abstract equation. We experience it's reality bit by bit through the striving of our own life forces towards levity. We recognize gravity's archetypal image in the growth of a fir tree, a forest, and of all living beings.

Every living process precipitates solidity and weight. The same processes also take hold of existing solid matter, transform it and lift it out of its heaviness. Organic life would lose itself in levity if it did not have its own counterimage as a balance. It is through the living concept, their own archetypal image, that solidity and gravity are recognized, realized and overcome.

Center of Gravity

The force of gravity grips firm objects in similar ways to those of the forces of motion, but only to move them in one direction, i.e. towards the center of the earth. Physics teaches that the pull that gravity exerts in the different parts of a body can be combined geometrically in one point, the center of gravity. Such an object could be a lightly compressed ball of sand. This ball then has a center of gravity that represents the combination of all the different centers of gravity of the many grains of sand.

The Goetheanist is less interested in the calculations of the centers of gravity than in their phenomenology. He has to

introduce new concepts of the center point and the boundary lines which differ from those held by conventional science. An imagined rather than a defined concept discerns the separating line, the point, and the separating plane to be areas of passing and arising. These are the places where forces take hold of matter in space, are enhanced into colors, flashing over as sparks, where they transmit a movement impulse from one object to another, or else become a wave, freed from material movement. From a strictly spatial view, for example, the dividing line between a black and a white surface is neither black, white nor gray because just on the line one has ended but the other has not yet started. The transitions, which we called separations, stand out from the spatially finished world. They are zones of origin, acted upon by living spiritual forces as well as by the latter's external extensions into physical forces.

Gravity does actually act upon points within objects. The concept of the point consists in reaching out to what is observable in the outer world, i.e. the contraction of an interconnection of boundaries. The point *is* the activity of contraction. Each such point is a "center of gravity". The other aspect of a point is the presence of organic life, the germinating point. Hence, a genuine point is discerned to be both the center of mechanical gravitation *and* the state of origin of organic levity.

Inertia and Movement

The force of inertia is often presented as gravity's twin. On the whole, the layman does not differentiate between the two. If he moves a book up and down on his flat hand in order to estimate its weight, he not only perceives the pressure due to its weight on his hand but also the resistance exerted by the solid matter against its acceleration. For billiard balls gravity is mostly irrelevant. Their movements are determined by their inertia.

What *is* inertia? Like gravity, it is fixed in the center of its object and hence does not work from the outside inwards. It is considered to be less a force than the resistance against changes in the speed or direction of movement which is equated to the body's material "mass". It becomes apparent as "centrifugal force" and most clearly so in circular movements. Inertia resists movement changes but is there to be seized and overcome by the forces of motion. We recognize inertia as the material counterpart of the force of movement. However much it may resemble gravity, it is nevertheless different in its nature since it originates in the element-creating movement, in the formation of water. Water's living streams have, by necessity, to encounter solid objects. Since solid structures are essential to nature, water, too, contains the beginnings of solidity. It not only freezes to blocks of ice which it moves about mechanically, but water itself becomes subject to density, gravity, and the laws of mechanics. To the extent that this happens, the unity of the original living movement will disintegrate into its temporal and spatial imprints, i.e. force of movement and opposing body. Material resistance is the obstacle against which the force of movement measures its strength. Persistence, resistance, and inertia describe the properties of matter, *not* to be force and *not* to be active.

Solidity is a product of the organizing life, the enhancement of all element-forming forces combined. Solidity therefore contains the imprints of the formation of warmth, air and water, although in the shape of their counterparts. We may presume the substance-bound forces of cohesion and density to be the counterpart of warmth formation, elasticity to be the counterpart of air formation, and inertia to be counterpart of movement and water formation. Without the inertia of substances the forces of movement would be superfluous. These opposites constitute a true polarity since they both originate from living movement. Brought together by technology, movement forces and inertia reunite to become mechanical movement.

RUDOLF STEINER's work faces all who encounter it with the question, Do I wish to pursue a path of spiritual development? This is because Steiner's thoughts, forms of artistic expression and social innovations imply a search for a spiritual view of the world. His philosophy, Anthroposophy, calls for the enhancement of thinking to spiritual observation.

Rudolf Steiner
1861 - 1925
Photography 1918

When Rudolf Steiner started to study the natural sciences in Vienna, he met the Goethe researcher, Karl Julius Schröer. On Schröer's recommendation he was entrusted at the age of twenty-two with the editing of Goethe's Natural Scientific Writings, a task that would take him fourteen years to complete. During this period of his life Rudolf Steiner came to link his thinking to Goethe's views. He discovered that Goethe's view of the world contains the method for a scientific understanding of organic life. Goethe had found such ideas as the archetypal plant, and the Ur-phenomenon of colors as creative realities. In

his Introductions to Goethe's Natural Scientific Writings, and in books written during the same period such as "Theory of Knowledge of Goethe's World View" and "The Philosophy of Freedom", Rudolf Steiner showed that these archetypal ideas have their origin in thought activity which is accessible to inner observation.

Even in childhood Rudolf Steiner found himself surrounded by spiritual beings and occurrences that were not perceptible to other people. As an adult he was able to explore the supersensible world in detail. He would have remained a clairvoyant among others had he not succeeded in building a bridge to modern science. He found that, with some training, any person could become capable of observing his or her own activity in forming concepts. Pure thinking attained in this way is already a supersensible experience.

At the turn of the century, Rudolf Steiner began to make the results of his spiritual research available to a wider public. In his works, namely in "Knowledge of the Higher Worlds", "Theosophy" and "Occult Science, An Outline", he gave methodical descriptions of the spiritual world and of the path of knowledge leading to its perception. In the years before World War One, he gave artistic expression to his insights in his Mystery Dramas, in the art of movement which he called "Eurythmy", and in the art of sculpture and architecture to be seen in the Goetheanum. The new body of knowledge, Anthroposophy, emerged as a spiritual science permeated by Christianity, capable of enlightening all human endeavor. At its center stands Christ, the archetype of man. Working outwards from there, spiritual science will humanize the sciences and their fields of application.

An ever growing group of people came to recognize the importance of Steiner's work. This enabled him to dedicate the last years of his life to creating social forms through which spiritual science could bear fruit in education, medicine, agriculture and other areas of cultural life.

THE FABRIC OF TIME AND SPACE

Spatial Observation

Mechanistic physicists believed up to the end of the last century that it would be possible to base physical laws on classical geometry. A body, be it a grain of dust or the planet earth, was assumed to move along paths that could in all cases be described by Euclidian geometry. As early as the beginning of the nineteenth century, the field of geometry had been considerably extended. Projective geometry had depicted the laws of whole fields of lines in which it succeeded in dynamically including the "infinitely distant" periphery. On the other hand, Gauss and other mathematicians developed "non-Euclidian" geometries of hyperbolically or elliptically bent spaces. Modern day physics uses the concept of the "space-time continuum". According to Einstein and Minkowski space-time is assumed to be four-dimensional, where time, however, is calculated using imaginary numbers. The General Theory of Relativity defines space-time as equivalent to four-dimensionally curved gravitational fields.

Theories of space, from traditional school geometry to the latest intellectual acrobatics of particle physics, all suffer from a common misconception. "Physicists have come to see that all their theories of natural phenomena, including the

'laws' they describe, are creations of the human mind; properties of our conceptual map of reality, rather than of reality itself." (F. Capra) Scientists develop concepts of abstract geometrical bodies which never exactly fit natural objects. For this reason they never arrive at reality.

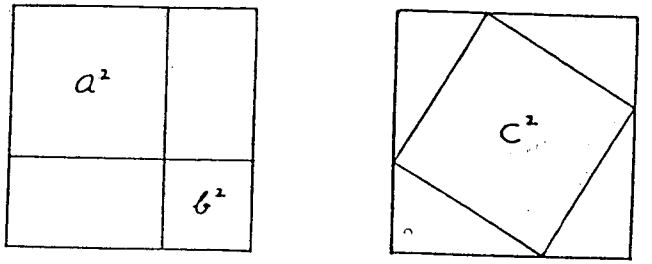
The split between thinking and reality, outlined by Cartesian and Kantian philosophy, was alien to the ancient philosophers. In Plato's *Timaios* we read of the beginnings of creation: "To the life which was to comprehend all living things, that figure was suitable which comprehends within itself all other figures. Wherefore He made the world in the form of a globe, having its extremes in every direction equidistant from the centre, the most perfect and the most like of all figures; for He considered that the like is infinitely fairer than the unlike." The different shapes of the geometrical solids play a part in the creation of the elements. Plato values the tetrahedron as the "original element and seed of fire", the cube as the formative force of the solid element. He conceives the outer shapes to be creations from the spiritual realm. Is it possible to reconcile Platonic thinking with the methodology of modern science?

Physical processes become more objectively apparent the less the experimenter interferes by personal activity. Things would appear to exist "by themselves", without man. The experimenter who cuts himself out of nature misses the point that even his withdrawal is an act which shapes the environment. The transparence of geometrical proportions lures him into the fallacy that the whole of geometry is nothing but a product of his mind, without discovering that the "axioms" line, point, and plane are perceptions of the outer world.

The observation of a line, point or plane is a dynamic process. A boundary line between red and green is the termination of one and start of the other in the place where they change over. In a point the surroundings are brought into the utmost contraction. In a plane, most of all in the celestial orbit, the utmost expansion is perceived. In the process of observation thinking is influenced; it reaches outwards, receives, recedes, shapes and transcends boundaries. Thinking that is reinforced by a theory of knowledge observes its own activity as it perceives space. In contraction, separation, and expansion it participates in the creation of space. There can be no objective observation of space without a thinking observer. If a point is the perception of becoming smaller, a line the perception of boundary formation, and a plane the perception of extension, where are the "ideal forms" compared to the "inaccuracies" of these shapes, e.g. those of a rock crystal? The most rigid external forms still contain a remnant of the dynamics of their arising and passing away. In every line, point and plane space borders not only on space but on time as well.

The Temporal Dynamics of Space

To understand Pythagoras' Theorem I need spatial imagination and an eye for equal measurements. I view the proportional dimensions of the squares and combine them into a context. In spatial imagination my thought activity is just as objective as when it measures, counts or combines. The Theorem of Pythagoras and similar laws describe a space consisting of building bricks, the archetype of which can be found in the monuments of ancient Egypt. The "vault" of a pyramid is



$$a^2 + b^2 = c^2$$

an *interior space* that is embedded in the solid element of earth and penetrated with warmth. Hermetically secluded from the impressions of the outer world, man enters into the inner space of his memory and expectation. Imagine this space transformed into the *light space* of a Greek temple! Irrational proportions of inimitable esthetics, its laws derived from the realm of the visual. The almost invisible convexity of the foundation, the organic rounding of the columns and the counterbalance in the roof-line evoke in the observer an impression of suspension and lightness. This space *arises* in the visual process. Its organic laws were known intuitively by the builders of antiquity. The spatial framework is taken over by a temporal effect that lifts it out of its fixed dimensions.

The extent of the time-effect in space is illustrated by the limitations on our individual visual space that usually pass unnoticed. The same spatial measurements and proportions are pictured differently in the minds of blind and sighted persons. People with a healthy visual sense resemble the blind in as much as they can never directly view the space behind their heads. An object in the lateral part of our field of vision appears blurred enough to become unidentifiable. Our

accurate visual field is so small that we cannot read more than a few words in a line without moving our eyes. The space which surrounds us is fragmented into a time sequence of small segments. Spatial observation is impossible without the mind that combines the temporal details into a unity. Even if, as human beings, we need sensory and nerve cells to perceive spatial pictures, these cells would be worthless without our thinking. The concept of space is a unity just as I am a unity. The comprehension of a tetrahedron or a sphere has to take place within myself. It comes about as a result of my mental work. In spatial perception my thinking reaches out with insight toward the borders of space, touches them and creates them anew in faint traces.

External space presents two faces to an observer: one which is filled with matter and the other by activity. The first comprises the measurements of rigid and mobile bodies, while the latter consists of activity by the observer towards the objects, as well as of activities evoked in the observer by his perceptions. The more attention the observer pays to the space in which activity takes place, the more important it becomes to him. For this region is the bridge between the objects and himself. All that he sees, hears, touches in space, all that he shapes there takes place in the space where he himself lives and acts, and which extends outwardly as far as the physical measurements of the objects.

Are we only describing a subjective process within that person? In as much as the "subjective process" really happens, it is a part of the objective world. But we perceive merely the external effects of our fellow's actions. The doing itself, even though it is a real fact, we can neither see, nor comprehend - at least not with our normal intelligence. The

problem remains unsolved until thinking is meditatively developed. The first meditative step is to observe thinking in the sense of Rudolf Steiner's *Philosophy of Freedom*. When a scientist talks about "space," he has a concept in mind, the truth of which he constantly tests. His efforts are rewarded whenever he participates in a thought process that goes beyond the boundaries of his person. As a second step the researcher intensifies his thought life towards inner activity. He recognizes in his thinking an inner power which is able to turn towards the outer world. He discovers the same power in his outwards directed actions. Through the thought experience of the initial step his activity now becomes an inner eye for perceiving the forces that create nature. He sees them as the "deeds and sufferings" of the world-creating thinking.

Forces of contraction, diminution, revert from the borders of such polarities as bright and dark back to the polarity's common source. A stream of forces generates outer boundaries as it withdraws from the elements which border on one another and retreats to their inner origin. That is true for every boundary formation of time, space, movement and, as we could see, even for the formation of numbers. We envisioned such a retreat of forces also in the process of pure observation (page 128). There, as well, the outgoing activities are withdrawn to their origin in order to let the observer's self meet the outer content. Thus there is an inner connection of space formation and observation. Space indeed is a view, though not in the abstract formulation of Kant, but living-shaping, being permeated by the radiance of light (page 131). The observer finds the key to understanding a *light space* unfolding within the flow of time when he pursues thinking right into the visual process.

The Temporal Form of Three-Dimensional Space

Under a potter's hands a vessel takes shape on the wheel. The direction of movement of her hands in forming the clay is opposite to that of the wheel's rotation . By her activity the potter reaches outwards to the clay to which she gives form. Her fingers are in touch with the vase that arises. She lives with her imagination, feeling, thinking in the work of her hands. Her inner world is in contact with the ceramic vase at each instant, not only mentally, but in external reality. An inner space becomes visible extending from the thought world up to the external form of the vase. This external form is present as a time structure in the conceptually outgoing inner space as it arises and passes away. The temporal form of the pot corresponds to its physical outlines in all three dimensions. While the clay is being molded on the potter's wheel the boundaries of the temporal and the spatial shapes are identical.

An activity space opens up, beginning in the world of thought and extending to the arising and passing away of external spatial boundaries. Since the activity space touches upon, creates and dissolves the spatial structures in all their aspects, it is an exact counterpart of the three-dimensional space. It comprises forces of living action rather than objects. Its dimensions are not measurable for it is itself the actual origin of the measurable. The field of forces contains the element-forming powers, accessible for the researcher, who has some training in cognition, as living concepts. The formation of warmth, air, and water and their final condensation into solidity, reaches the outer world. Where its gifts are brought forth, spatial and temporal boundaries, the boundaries between the inner and outer worlds, are created. Space seen from the inner world is time.

The Region of Origins

We often view time as a train traveling from the past into the future. The year starts closer to the past and ends closer to the future. It is the impression of an inactive observer who experiences the movement in space, running counter to the flow of time. If we leave the observer's capsule, we become part of the flow that begins with our phantasies and intentions, and ends with a deed. An interruption takes place. The originator cannot take back what he did. He returns to the scene where the act took place to observe its effects. He perceives the outer impressions so as to process them and transform them into new resolutions.

Time's flow is not a closed circuit. It originates as outgoing action from the future, breaks off in the present, and starts up there again as a perception which goes into the past as it becomes memory. The flow of the memory finally fades away into the inner world. Details are forgotten. I "know how to do" something when I have forgotten the difficulties of the learning process. Childhood memories evolve into capabilities later on. Time's stream flows into what I am; it opens up towards the inner world where the spiritual life comes into its own. The region of origins unites within itself both past and future. It contains the potentiality for deeds in the form of intentions and abilities.

The thinking human being is much more at home in the world of origins than in the outer world. For it is the region where he finds his own inner unity, from which he reviews

his insights, and experiences their truth. This realm directly affects his encounters with the external present. A person, reaching out with his hand or with his gaze to an object, lives in the outgoing stream of activity. As soon as he touches and perceives the object, he withdraws his outwardly directed activity. He then lives in the opposite stream of doing which carries the impressions into his memory. The shift from activity to counteractivity happens so quickly that it is easily overlooked. This turning point becomes a deep experience when an emergency occurs. In a moment of unexpected danger, everything may depend on a person's presence of mind. He has to interrupt his actions immediately. He is thrown back into himself. Time stands still. The victim of the incident is paralyzed with fright, on the border between life and death. In his fright he experiences the gap between his inner self and the outer world. The rescuer intervenes immediately. Lifelong destinies may come to their decision within seconds. The victim experiences the rescue as something radiant, even before he becomes aware of the details.

A similar shock, even if on the smallest scale, is caused by any observation. At the moment it encounters the external, the stream of my outgoing action is disrupted. I withdraw my action. In the creative realm of time there is a gap extending from the external present to the realm of origins. This gap is filled with the perception of radiance.

A Space of Radiance

How is inner radiance related to the light of external optical phenomena? To come to an understanding of the *light space,* we focus our attention on everything in space which does not hold a content. We disregard the extent of volume, surface and distance. Thus, we ignore everything that appears as a bodily object in space. The airy, liquid, and solid elements disappear, as well as pressure, suction, etc. What is left behind? A pattern of boundary lines, intersections, and dividing surfaces, the meaning of which consists only in the ending of one manifestation and the beginning of its opposite.

It is evident that a separation itself does not just consist of the absence of what it divides, but that it contains the separated opposites, such as light and dark, in their common state of becoming. These germinal points or lines appear at first to be a kind of nothing. More accurate and thoughtful observation reveals how the common source of all polar phenomena emanates into the outer world at the separations. This follows laws of its own. If what is common to two of these separations is pursued, one sees that each germinal point contains something infinitely large which presents itself as a line unlimited in length. Here are the common color-creating sources of what appears bright and dark. They expand into rays wherever the simplest linear relationship of separations is present. This linear radiance combines into a network of light shapes and surfaces. All this arises in the gaps and seams of our material spatial structure because it is along these separations that the primordial state is active. We can see in this fabric the outer manifestation of force in its primeval form. Space is formed by radiant forces.

Our concrete world presents itself to us as physical bodies that are both shaped and in movement. The space occupied by matter is surrounded and permeated by a space of rays weaving through all gaps, joints and inner and outer boundary surfaces. It is creative origin, the becoming and vanishing of space. The rays of force come from the common origin and extend into the world of time and space. They are the appearance of the origin.

Light lives in the whole of radiant space although it prefers the surfaces and borders where it spreads its colors. The various colors appear and disappear in organic interchange with the complementary colors of our "eyes". They illuminate the temporal, inner aspect of surfaces. It is an illusion that we look at the objects in space from outside. We view objects with our eyes from the inner world outwards; thus we see space's temporal, inner aspect. The fact that we also dwell with the optical impressions in the realm of time becomes evident as soon as the light disappears, taking with it the whole world of the eye.

The Radiance of Warmth

The seven-fold fabric of time and space embraces the punctual, linear and surface dimensions with their temporal counterdimensions, as well as the unitary *warmth space* which contains the potentiality of all the other dimensions. It is the arena of physical and physiological processes.

We have come now to the phenomena of the radiance of warmth or heat. Heat is comparable to the tramp with his magic hat in the fairy tale, who only had to wish himself to be at some distant place to find himself there at once. Heat

disappears from a kettle and reemerges at the same moment some distance away warming up another object. Although heat radiation will "only" warm a body up without illuminating it, it spreads out according to laws similar to those of light. Where light can shine, heat can also radiate. In this state the heat force gives up all connection with the material world. As it lacks gravity and material density, it assumes a primordial state that is not yet spatial or even temporal. In the lightning-like nature of these phenomena we see the direct presence of the common origin of time and force in the external world. The radiation appears initially as a negative phenomenon, a shadow, and only perceptible through the absence of any other external manifestation. This means that matter, extension and duration are absent; not higher or lower temperatures are considered, but germinal points from which both emerge.

Let us observe a piano player in terms of his body heat. We will exclude the complexity of temperature and heat circulation within his organs, except for the muscle heat directly connected with his play. Every muscle, even the smallest, produces a heat impulse with each contraction. Let us also exclude in this context all electrical and chemical muscle phenomena. Then the whole piece of music appears in the different heat impulses emitted by the player's muscles. Such a musical profile consists of the warmth differentiations of the various muscle fibers and bundles, combining in harmonious fields as they weave back and forth over the whole body; for every finger strike on the keyboard triggers a corresponding action in other muscles of the body, e.g. neck, back, legs, etc.

The different variations of warmth can only be artificially separated from each other. As no muscle fibers move inde-

pendently, the warmth changes in the different muscles combine into an organically formed warmth shape. This warmth is a direct result of the player's activity. It lies in the nature of warmth, and that of activity, that they are the outer and inner aspects of the same process. Therefore the warmth aspect of a piece of music is still a process in time, involving arising and passing away, and only transiently touching the physical-spatial world.

We can now observe a further phenomenon within the structure of warmth. The warmth component of the musical piece that arises from the pianist's body transfers heat radiation into the environment. Let us follow with our thinking the appearance of the heat radiation in detail so as to arrive at new concepts. This radiation shows similarities with that of light which generates brightness and darkness along spatial boundaries. However, it works more in the realm of time where cold disappears and is replaced by heat, and vice versa. The rays of heat abound at the joints in time where a transition between heat and cold exists. Let us examine the origin of our musical warmth formation from this point of view.

The whole content of the piece of music is present in the performer before, during, and after his performance. It exists as an overview that extends beyond itself into the world during the performance. This radiantly active overview takes effect in the striking of every note; it locates each sound in time, connecting it with all the preceding and following sounds. The action always takes place at the transition from one sound to the next, at temporal discontinuities. Every movement, however small, stems from the ability to play the whole piece. This faculty sheds its radiance over the time

aspect of the piece of music, providing an overall view of it, including all the details of its past, present and future. The rays from this activity not only connect all discontinuities but lead in the form of melodies from one sound to the next, holding the rhythmical lines apart so as to combine them into a harmony.

The warmth phenomena and the player's actions are identical but viewed from two different aspects: the external arising from within, the internal in transition towards the outside. In the interplay between warmth activity and its withdrawal, the origin of both is present. It imparts a spiritual radiance to its activity. Wherever an activity changes into its opposite, i.e. where at the point of transition *no* action takes place, a gap is formed, through which the inner origin rays out directly. Once we are able to acknowledge the fact that such a radiance is possible, we will perceive its outer manifestation. The observer finds that at the changeover from warmth to cold, bright to dark, sound to silence, and resistance to void, something inserts itself that belongs to the phenomena of polarity which, however, only becomes perceptible by their absence. Rays resemble sparks. Their appearance is at the same instant their disappearance. They are the external trace of their own creation which only becomes visible at the transition from the inner to the outer world.

Is Light Electromagnetism?

Since Maxwell's and Hertz' discoveries, light and heat radiation have been considered to be electromagnetic waves. The proof appears overwhelming: electromagnetic fields spread with "the speed of light" and obey optical laws. Arti-

ficial light can be made from electricity. Electromagnetic radiation comes from the cosmos. Like the principle of energy, electromagnetism has become a way to view the world. Every radiation, every body, be it an atom or the combined mass of all the stars in the universe, "consists" of electromagnetic fields, which are even supposed to produce thoughts in our brains.

A Goetheanistic presentation of electromagnetism, or even the source material about what has been elaborated, would be beyond the scope of this book. These phenomena await the attention of new minds. Electricity appears in the thunderstorms above equatorial rain forests: in the interchange of accumulated hot air and the vapor that rises from the earth. Magnetism arises in the polar regions, whether as magnetic iron ore, or as the earth's magnetic poles. The two-dimensional colors of the northern lights are in complete contrast to the noise of equatorial lightnings. Magnetism is at home in nature wherever water is frozen and where the earth's rotation is concentrated in its axis. The origin of electricity and magnetism is to be found where elements situated between warmth and solidity are undergoing densification.

How can the electromagnetic properties of light, heat and other radiations be understood? To the extent that I encounter the outer world, I reach outwards with my living thought forces. I produce, among other forces, heat radiation. This is what I have brought forth: a germinally active force. The effect extends outwards where it encounters solid objects such as measuring devices. It tackles airy, watery, and solid objects, in the course of which electromagnetism comes into existence as a countereffect. Vice versa, electromagnetic waves can be transformed into heat. In both instances "heat"

is present but with a distinct difference in quality. Are electricity and magnetism countereffects? Do they arise indirectly from physical objects and technological devices, whereas the original forces of movement, warmth, etc. can be formed directly out of the inner world? It will be possible for exact observation to pursue an effect back to its origin in each case, and to discern, whether it is a direct expression of spiritual life or its dead echo.

Organic Radiation

Any theory of light, and how it radiates, will remain incorrect if it fails to include the force emanating from the human gaze. Perceiving the quality of a look belongs to daily experience. When somebody looks at us we sometimes feel that the gaze goes "right through," whether it is an eye contact, or whether we are looked at from the side, or even from behind. Our interest is less in the effects of the actual gaze than in the presence of something spiritual in space. By its mere quality, a gaze can bring about a relevant action without being itself action. Within it there lives the origin of activity. What is capable of external effects does not itself consist of effects. It comes to light in places where external actions are absent.

Let us imagine that we are among the audience in a concert hall. The appearance of the conductor, and the applause, give expression to the fact that one person represents the playing of the whole orchestra. When he lifts the baton at the beginning of the performance, the concert hall is silent. The eyes of the audience and of the players are directed towards him. The unity of the whole musical performance, including

such detail as the playing of each note, radiates throughout the concert hall by virtue of the conductor's personal presence. This happens on several levels: as unity of the whole musical piece at silent moments; as dynamic harmony when the conductor accentuates the playing of one group of instruments and moderates the others; as a line of rhythm in the exactness of his beat; as the transition from silence to sound when he calls on the entry of a solo instrument or, vice versa, when he imposes a sudden overall silence. The dimension-forming regions of time can be recognized on these levels, i.e. the unity of the time field, the dynamics of the harmony plane, the line of rhythm, and the simple discontinuity. It is also a spatial process, since the entry signal for the kettle-drum, say, reaches all the way to the striking of the drum; the rhythm is expressed in the flow of the conductor's and the players' linear movements; the accentuation of a group of string instruments has the geometrical character of a plane. The orchestra unites itself, centered by the conductor, into a temporal-spatial entity.

The boundaries of the fabric of time and space show their true nature as fields of spiritual radiance. Living thinking approaches the outer world in the form of different activities. The origin of activity shines through wherever there are temporal-spatial transitions. These are the places where warming-up changes into cooling-down, pressure changes over into suction, movement changes its direction, and where gravity and its living counterforce are in equilibrium. To this boundary region also belongs the spatial *unity* of the points, lines and surfaces, in so far as it represents the sum of all possible boundaries. A "spatial content" may consist of the material volume of a mineral. At the same time it exists in all

the seams, inner boundaries and inner surfaces of the mineral which do not occupy any additional space, and in the *possibility* of new boundary structures. The unity of all the possibilities of forming new boundaries in time and space is the field of warmth radiation, the place where the outward-going primal radiance transforms itself into heat and cold. The temporal-spatial surfaces form the field of light radiation, while the lines form the field of sound radiation. Farthest out in the outer world, the primal radiance is refracted at all point-shaped structures such as crystals, or cell nuclei.

Man himself stands as a participant within the radiance of the element-forming fields. Any schematic approach would fail to encompass the essence. A field of sound, as created in a concert hall, contains, in addition to rhythmic-linear elements, those of planes and of spatial unity. It enters as a stream into the audience's experience leading to internalized images filled with feeling.

The radiance entering into the fields of the fabric of time and space from the realm of spirit disintegrates in the course of shaping the outer world. It causes physical countereffects. The concept of time and space, which is founded on theory of cognition, leads to a new understanding of force fields. What can a field with "ability", "energy", or "probability" be if not the spatial presence of what makes the force happen? What is defined and calculated without imagination in conventional physics possesses spiritual life in the reality of organic physics.

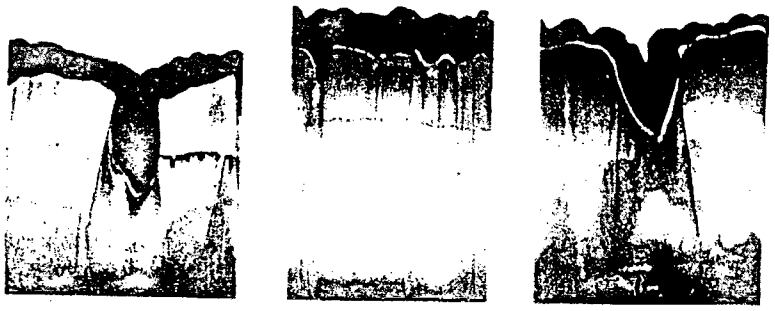
A New Direction in Scientific Research

The activity of planetary forces was known in many details by earlier wisdom, such as we find in Paracelsus' writings. Based on Rudolf Steiner's teachings, L. Kolisko, E. Pfeiffer, T. Schwenk and other researchers have confirmed the presence of physiologically active planetary radiation. In systematic experiments, wheat sprouts showed clearly inhibited growth when the radiation of Jupiter or other planets was altered by conjunction or opposition, for example, with the moon. Similar evidence was obtained with paper chromatograms, with copper chloride crystallizations, and with the form variations water drops show when they fall on a watery surface. These experiments document effects which can only be understood as life processes.

The theoretical and practical details of these tests have been extensively published by the authors named in the *Notes*, and others. They are not the usual quantitative tests but rather the statement of the *test picture*, the presence or absence of typical forms, their patterns and proportions. The mere fact that such methods exist and produce useful results raises questions which are mostly avoided by conventional physics. Is it possible to come to scientific results by means of pictures instead of mathematical equations? Are such boundary areas of time-space as the capillary flow in a chromatogram, the formation of a crystallization pattern, or the metamorphosis of the shape of a fallen drop, areas sensitive to the effects of life? — Temporal events are recognized through the images of the expectation and memory of the observer. Our thinking observation has genuinely the ability of forming images. This faculty is the most important instrument for the knowledge of living processes, the completeness of which we only find in time.

The access to organic physics can be gained when scientists make the activity and power of their thought life part of the field of observation. If the human spirit can think freely, what prevents him from sending energy into the outer world? In this case the principle of the conservation of energy is wrong. Insights of this kind pave the way towards a research that understands anew the context between human activity and physical force. A science based on such foundations *is* alive. It does not suffer from the gap between idea and reality, for its ideas are powerful and create reality.

For reasons of its basic methodology physics has distanced itself from life. A physicist, who pursues a science of life, is devoted to life. Not only a set of moral standards, comparable to the Hippocratic Oath in medicine, will belong to the new physics; creative thought itself, the basis of science, can be recognized as the source of ethics as expressed already by our language in the relationship of the words for thinking and thanking, and for life and love.

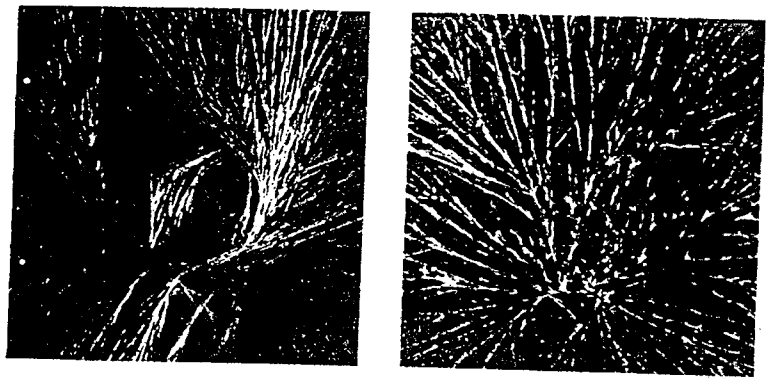


Paper Chromatograms by Lili Kolisko

These pioneering chromatograms were obtained one day before, during and one day after the eclipse of Jupiter and Moon in September 1929. Mrs. Kolisko allowed first stannous chloride ($SnCl_2$) to rise in the filter paper before letting silver nitrate ($AgNO_3$) "rise through the stannum" on the above dates. The chromatograms show a capillary dynamic of chemical reactions of the two metal salts, their characteristic contours being impressively extinguished during the eclipse (center picture).

Lili Kolisko's method has led to extensive research in the documantation of planetary forces. It also became, similar to the Pfeiffer Crystallization, an established tool in medical diagnosis and food quality testing.

From: Lili Kolisko, *Der Jupiter and das Zinn.* Published 1932 by the Mathematical-Astronomical Section at the Goetheanum, Dornach/Switzerland.



Sensitive Crystallization Test

A copper chloride ($CuCl_2$) solution to which a solution of the tested material was added crystallizes at the bottom of a glass dish when the water evaporates. In the above samples Lovage (Levisticum) was tested: Young leaf (left) and dying leaf.

In more than 60 years since the discoveries made by Dr. Ehrenfried Pfeiffer the Sensitive Crystallization has been developed into a reliable method of testing the quality of food produce and of testing blood as an aid in medical diagnosis. The above photographs were published 1971 in *Evolution und Heilmittel* by Weleda A.G., Arlesheim/Switzerland and Schwäbisch Gmünd/Germany.

NOTES

Page

5 FRITJOF CAPRA: *The Tao of Physics*, Bantam Books 1984 (first printing 1976).

8 NOVALIS: *Fragments (German edition by Ewald Wasmuth).*

SAMUEL HAHNEMANN: *Organon of the Rational Art of Healing* (1810).

9 RUDOLF STEINER: *The Theory of Knowledge Implicit in Goethe's World View, (1886), (Science of Knowing,* Mercury Press, Spring Valley, NY*) ; Introductions to Goethe's Natural Scientific Writings (1883-1897), (Goethean Science,* Mercury Press, Spring Valley, NY*)* and other works by Rudolf Steiner.

THE UNOBSERVED ELEMENT OF OUR SPIRITUAL LIFE: Rudolf Steiner, *The Philosophy of Freedom* (1894), Chapter III.

11 PERCEPTION: Rudolf Steiner, *The Philosophy of Freedom,* Chapter V (translated by Michael Wilson), Anthroposophic Press.

12 CONCEPT OF THE EXTERNAL: I *perceive the mental picture in myself in the same sense as I perceive color, sound, etc., in other objects. I am now also able to distinguish these other objects that confront me by calling them the o u t e r w o r l d, whereas the content of my percept of my self I call my i n n e r w o r l d.* Rudolf Steiner, *The Philosophy of Freedom,* Chapter IV (Translation by Michael Wilson).

13 W. WESTPHAL: "*Physik, Ein Lehrbuch*", Springer Berlin 1950, Paragraph 11.

14 F. CAPRA: "*The Tao of Physics*", Chapter 14.

CONCEPT OF FORCE: A comprehensive presentation of Goethe's method developed further by Rudolf Steiner, and its confrontation with conventional physics, is contained in Ernst Lehrs' book *Man or Matter*, (1950), see Chapter VIII.(Anthroposophic Press)

LET...BE PRESENT: In Summer 1952, I had the privilege to hear Martin Heideggers last course of lectures *What means Thinking?* He called objective observation *to let be present* (*vorliegenlassen*) and explained to us the relationship of thinking and thanking. In the Middle Ages there was one common German word (*gedanc*) for thought, emotion, devotion, and gratitude. M. Heidegger, *Was heißt Denken*, Part II, Chapters III and VIII (Edition: Max Niemeyer Verlag, Tübingen, Germany).

17 HENCE DEPRIVING IT OF A FORCEFUL EFFECT: *We will here only anticipate our statements so far as to observe, that light and darkness, brightness and obscurity, or if a more general expression is preferred, light and its absence ("Nichtlicht"), are necessary to the production of colour.* Goethe's *Theory of Colours*, Introduction (translation by Charles Lock Eastlake).

20 A BASIC ENTITY IS THUS QUANTITATIVELY DERIVED ...: *With this conviction we look upon the mistake that has been committed in the investigation of this subject as a very serious one, inasmuch as a secondary phenomenon has been thus placed higher in order the primordial phenomenon has been degraded to an inferior place; nay, the secondary phenomenon has been placed at the head, a compound effect has been treated as simple, a simple appearance as compound: owing to this contradiction the most capricious complication and perplexity have been introduced into physical inquiries, the effects of which are still apparent.* Goethe, *Theory of Colours*, Paragraph 176 (translation by Charles Lock Eastlake).

23 ST. AUGUSTINE: *Confessions*, Book XI, Chapter 27.

24 NOVALIS: See note to page 35

RUDOLF STEINER: *Introductions to Goethe's Natural Scientific Writings*, Volumes III and IV.

TIME BODY: Lecture by Rudolf Steiner, *The Anthroposophical Research Method*, The Hague, April 10th, 1922.

COUNTERDIMENSIONS: Rudolf Steiner, *The Relation of the Diverse Branches of Natural Science to Astronomy*, Lecture on January 15, 1921, and answers to questions after the lecture "*Anthroposophy and Agnosticism,*" The Hague, April 12th, 1922.

35 NOVALIS' CONCEPT OF TIME: The following Fragments are translated from the German Novalis edition of E. Wasmuth and are numbered accordingly. They originate from the years 1798-1800 and are quoted in chronological order.

Time and space, more dynamically approached. 1377

Time and space originate together and seem to be one, just like subject and object. Space is persistent time — time is flowing, variable space—space, the basis of everything persistent — time, the basis of everything variable. Space is the pattern — time is the concept — the action (genesis) of this pattern. (To each moment I have to add in thought a preceding and a subsequent one). 1399

Pure observation of the phenomena of time and space. 1378

Philosophy is the art of self-separation and unification — the art of self-specification and generation.

d	*g*	*b*	*a*
The space	*the plane*	*the line*	*the point*
(extension)	*(resistance)*		
(positive)	*(negative)*		
δ	γ	β	α

The time-space — the time-plane — the time-flow — the moment

d and δ *— g and* γ *— b and* β *— a and* α *originate together.* 1383

Time is inner space — space is external time. (Their synthesis) Figures of time, etc. Space and time originate together.

The force of individual entities of time is measured by means of space — the force of individual entities of space by means of time (duration).

Each body has its time — each time has its body. Constructions of time (time triangle — time figuration — time stereometry — time trigonometry.) 1382

Space as a precipitation from time as a necessary consequence of time. 1379

Space passes over into time, just as the body passes over into the soul. The process of simultaneous generation on one side. 1380

38 HEARTBEAT AND RESPIRATORY RHYTHM: Rudolf Steiner, *Fundamentals of Anthroposophical Medicine*, Lecture on October 27, 1922, Mercury Press, Spring Valley, NY.

Günther Hildebrandt, "*Die rhythmische Funktionsordnung von Puls und Atmung*," Habilitationsschrift für das Fach Humanphysiologie und Balneologie, Marburg/Lahn 1958.

43 PROJECTIVE GEOMETRY: George Adams, *Strahlende Weltgestaltung*, Dornach (Switzerland) 1934, *The Plant between Sun and Earth* (1952), *Physical and Ethereal Spaces*, Rudolf Steiner Press, London 1965.

44 PHORONOMY: Ernst Lehrs, *Man or Matter*, Chapter VIII (see note to page 14).

THE VERY FACT THAT THE TOTALITY OF OUR SENSE EXPERIENCES ...: Albert Einstein, *Out of My Later Years*, (Physics and Reality, 1936).

45 SIZE, SHAPE, FORM, POSITION, MOVEMENT ...: Rudolf Steiner, *Introductions to Goethe's Natural Scientific Writings*, Volume IV, Chapters II and III (1897).

TWENTY YEARS LATER ...: Rudolf Steiner, *Course on Light* (1919/20), Lectures One and Ten. *If we just go along with what is available to science, today we have no possibility of judging in which way our geometrical and phoronomical concepts relate to what appears out there in nature. We make calculations of the natural phenomena in so far as they are physical. But whether we are sketching anything there just on the surface, or are penetrating into the essence of nature, cannot be determined. And if one begins to think rigorously, particularly in the physical sciences, one will come to a terrible dead end road and then realize that one can get no further. Progress will only be possible if one starts to learn about the o r i g i n * of our phoronomical concepts, of our mental representations of the numberwork and geometry, as well as about our concepts of simple movement, not of forces.* (Lecture Ten)

* not highlighted in original text.

52 ONLY SECONDARILY ...: In his Lectures *Evolution in the Aspect of Realities*, Lecture Two (November 7, 1911) Rudolf Steiner states that the origin of time preceded the origin of space for reasons of spiritual necessity.

MY RESEARCH IN THE FUNDAMENTALS OF NATURAL SCIENCE ...: The dialogue can do no more than indicate that the training of a living thinking calls for a path of inner development. Guidance towards a spiritual path, to the beginnings of which I refer here, can be found in Rudolf Steiner's writings, namely in *Theosophy*, (Chapter: The Path of Knowledge), *Knowledge of the Higher Worlds*, and in *Occult Science, An Outline*. In the chapter: Cognition of Higher Worlds — Initiation, of the book *Occult Science* Rudolf Steiner states: *The path along which the messages from spiritual science lead us to sense-free thinking is quite safe. There is, however, still another path which is safer and, above all, more exact, but it is also more difficult for many human beings. This path is described in my books "Theory of Knowledge of Goethe's World View" and "Philosophy of Freedom". These writings offer what human thought can acquire if thinking does not give itself up to the impressions of the external physical sense world, but s u b m i t s o n l y t o i t s e l f. It is then pure thought which acts in the human being like a living entity, but not thought which merely indulges in memories of the sense world. In the writings herein mentioned nothing is derived*

from the communications of spiritual science itself. Yet it is shown that pure, self-active thinking may throw light on the problems of world, life and man. (Translation by Maud and Henry Monges)

53 AS WE ARE MOST STRONGLY CONNECTED WITH OUR LIVING THINKING WHEN WE SLEEP DEEPLY: Although we strive for wakefully conscious thinking, we experience, in an inkling, immersion in a sphere of intense spirituality during profound sleep.

83 CIRCULAR EARTHLY MOVEMENTS: The sun circle was the primeval cosmic form to the cultures of antiquity; the square, later the rectangular cross, represented the archetypal form of the earth. The sun circle is the cosmic periphery brought into space. Contemporary geometry mostly views the circle as expansion from a point, e.g. as a wheel. The peripheral rounding, which has become solid in space as spherically shaped seeds, is by the growing plant dissolved into spiral and hyperbolic forms. Just the latter forms have been observed ever more frequently in the skies, be it in cloud formations, northern lights, spiral nebula, or be it in the flow of the surface of Jupiter, or even of the sun.

84 UNSCIENTIFIC HYPOTHESIS: Rudolf Steiner, *Introductions to Goethe's Natural Scientific Writings,* Volume II, Chapter: Boundaries of Knowledge and Hypothesis Formation. (*Goethean Science*, Mercury Press, Spring Valley, NY)

86 EXTERNAL SPACE HAS ONLY THREE DIMENSIONS: Rudolf Steiner, *Goethean Science*, Chapter: The Goethean Concept of Space, Mercury Press, Spring Valley, NY.

89 SEPARATION OF SCIENCE AND RELIGION: Albert Einstein, *Out of my Later Years*, Chapter: Science and Religion (1941), as quoted on page 120.

91 ORIGIN OF MOVEMENT: After the birth of time and space, movement is brought into the world, comparable, at first, with the movement of thinking, then becoming movement in space. Rudolf Steiner has

elaborated these relationships in the lecture cycle *Evolution in the Aspect of Realities*, Lecture Four (November 21, 1911).

PURE THINKING: see second note to page 52.

113 "SUBSTANTIAL POINTS" AND "SOURCES OF ACTIVITY": Hans Börnsen, *Leibniz' Substanzbegriff und Goethes Gedanke der Metamorphose* (page 49), Verlag Freies Geistesleben, Stuttgart 1985.

"Every human being is a calculation, just as every calculation is a human being: Novalis, *Mathematische Fragmente* (1799/1800), Fragment No. 1300, 1301 (German edition by E. Wasmuth)

114 SPIRITUAL BOND: Goethe, *Faust I*, Scene of Mephistopheles and student (*Fehlt leider! nur das geistige Band.*)

120 ELEMENTS: Here used as a term for the states of material condensation. In the ancient theory of the elements fire was the highest element. Since the last century, orthodox science has used the term "element" exclusively to denote the basic chemical substances of the periodic system. The flame is considered to be a form of chemical reaction in which heat energy is set free. Rudolf Steiner developed a new concept of matter in describing it as a consequence of the workings of spiritual forces. He characterizes warmth/heat as the physical phenomenon that is most free of density and gravity, being itself already a transition to the sphere where spiritual forces are active. What is of concern here is not a regression to the concepts of antiquity but the recognition of a transition between what is spiritual and what is physical.

121 WARMTH AS THE FORMATION OF FORCE IN TIME: Rudolf Steiner's presentations of the common origin of warmth and time, of the airy element and space, and of the watery element and movement point the way ahead. Compare the descriptions in his book *Occult Science, an Outline*, Chapter: Cosmic and Human Evolution (1909), and in his Lectures *Evolution in the Aspect of Realities* (1911).

131 LIGHT AND SPACE: Rudolf Steiner characterized as the spiritually creating counterpart of the four earthly elements the warmth ether, light ether, sound or chemical ether, and the life ether. *The Bridge between Universal Spirituality and the Physical Constitution of Man*, Lecture given on December 17, 1920.

CITIZENS OF LEGENDARY SCHILDA: Town in Saxonia whose citizens were famous for their foolishness. *Volksbuch, Die Schildbürger* (1598).

136 *IN STATU NASCENDI*: (Latin) in the state of becoming.

137 MOVEMENT CHARACTERISTICS OF WATER AND AIR: The brilliant investigations of Theodor Schwenk provide impressions of the great variety of internal watery surfaces. Particular test conditions influence the production of the differing forms. Theodor Schwenk, *Sensitive Chaos* (Schocken, New York 1976) and: *Bewegungsformen des Wassers*, Stuttgart 1967.

138 WATER IS ... DEMATERIALIZED: This train of thought tries to describe one aspect of the wide and challenging topic. Rudolf Steiner has given numerous indications about the creation and annihilation of matter, notably those in the third of his "Bridge Lectures" (Mercury Press), and his Lecture on April 11, 1922 in The Hague: *Important Anthroposophical Results*.

139 ETERNAL ALTERNATION: Goethe, *Song of the Spirits over the Waters* (Poem, 1779).

145 ORGANIC LANGUAGE: Ernst Lehrs, *Man or Matter*, Harper, New York 1950 (new edition by Anthroposophic Press, Hudson, New York), page 332: *The emergence of the sense-bearing word from the merely ringing sound is an exact counterpart to what takes place in nature when the play of organic liquids, regulated by the chemical ether, is caused by the life-ether to solidify into outwardly perceptible form. By reading in this way the special function of the life-ether among the other three, we are led to the term 'Word-ether' as an appropriate second name for it, corresponding to the term sound-ether for the chemical ether.*

149 NOVALIS: *Fragmente*, German edition by E. Wasmuth.

Experimentation involves Nature — genius — i.e. the miraculous ability to hit upon nature's essence — and to act out of its spirit. The true observer is an artist — he has a presentiment of what is meaningful and knows how to feel out what is important from the strange medley of transient phenomena. 1435

These gentlemen have not yet a clear view of what is best in nature. Here, Fichte will still make his friends ashamed, and Hempsterhuis anticipated this holy path towards physics clearly enough. In Spinoza, too, we already find this divine spark in understanding. Plotin, possibly inspired by Plato, was the first to enter the sanctuary in the true spirit, and to date nobody has since penetrated it so far.

In many of the ancient scriptures there beats a mysterious pulse that marks the place where it touches the invisible world — a coming alive. Goethe ought to become the liturgist of this physics — he fully understands service in the temple. Leibniz's "Theodicee" remains forever a magnificent attempt in this field. A future physics will become somewhat like this, but admittedly on a higher level. If only one could have used another word instead of "admiration" in this so-called physico-theology. 1445

The truly idealistic path for the physicist is not to explain what has been combined and united on the basis of what is simple and divided, but vice versa. A state will never arise from a tribe, but a tribe might well come about from a state. Nature has originated out of specification. Gravity is explained out of sensibility, not sensibility out of gravity; electricity, etc. Through the life of thoughts, gravity's origin becomes explicable. The first chapter of physics belongs to the world of spirit. Nature cannot be explained while at rest, but only while it is proceeding towards morality. One day there will be no nature. It will gradually pass over into a world of spirit. 726

Life is something like colors, sound, and force. The romanticist studies life in the same way that painters, musicians and mechanics explore color, sound and force. A careful study of life makes a romanticist, just as the careful study of color, formation, tone and force makes a painter, musician or mechanic. 555

Light is in every case action — light is like life, active activity revealing itself only in the coincidence of relevant conditions. Light generates fire. Light is the genius of the fire process. Life is like

light, capable of strengthening and weakening, as well as gradual negation. Is it similarly refracted into colors? The process of nutrition is not the cause but only a consequence of life. 546

A problem is a solid synthetic mass that is disintegrated by means of the penetrating power of thought. Thus, conversely, fire is nature's thought force, and each body a problem. 324

Every flame is a generation of water. 1652

Goethean approach to the sciences — my project. 983

Every science needs to be poetized (from a letter from Novalis to A.W. Schlegel, February 1798).

153 NONLIGHT: See note to page 17.

ONE OF NOVALIS' FRAGMENTS: No. 530 of the German edition by E. Wasmuth.

157 SIMILIA SIMILIBUS: Samuel Hahnemann, *Versuch über ein neues Prinzip zur Auffindung der Heilkräfte der Arzneisubstanzen, nebst einigen Blicken auf die bisherigen (Essay on a New Principle for Ascertaining the Curative Power of the Remedial Substances, and Some Examinations of Previous Principles)*, in Hufeland's Journal der Heilkunde, 1796.

KARL KÖNIG: *Geister unter dem Zeitgeist*, Verlag Freies Geistesleben, Stuttgart.

LANDSCAPES OF THE EXTERNSTEINE AND THE MEGALITHIC GRAVES: In 1795 Hahnemann spent several months in Bad Pyrmont which is near the Externsteine. Megalithic barrows are located in the countryside around Hamburg and Moelln.

159 DROP-PICTURE METHOD: Theodor Schwenk, *Bewegungsformen des Wassers*, Verlag Freies Geistesleben, Stuttgart 1973.

Theodor Schwenk and Wolfram Schwenk: *Water, The Element of Life*, Anthroposophic Press, Hudson, NY, 1989.

HOMEOPATHIC MEDICINE: Samuel Hahnemann, *Organon of the Rational Art of Healing (Organon der Heilkunst*, 1810). In 1811

Avogadro published his calculations that led to the molecular theory of solutions; to this day they are considered by conventional physics proof that homeopathy cannot exist.

160 OUT-OF-BODY SPIRITUAL LIFE: Raymond Moody, *Life After Life* (1975).

PURE THOUGHT: See note to page 52

161 THE WORDS OF A PHYSICS PROFESSOR: Ken Greider, *Invitation to Physics*, Paragraphs 7-1 and 15-5 (Hartcourt Brace Jovanovich 1973).

165 JULIUS ROBERT MAYER: See Ernst Lehrs, *Man or Matter*, Chapter: The Fourth State of Matter.

166 W. WESTPHAL: *Physik, Ein Lehrbuch* (Springer Berlin 1950), Paragraph 23.

I. ASIMOV: *Understanding Physics* (Mentor Book 1969), page 100.

169 GROWTH ... OVERCOMES GRAVITY: Goethe knew the spiral tendency to be the movement pattern inherent in all growth. In growth's counterpart, the fall under gravity, spiral movements also appear. They are considered to be a mechanical twist, for instance, in the case of a stone that is thrown or in falling leaves or snowflakes. The question is whether the spiral movements are an essential part of the fall as the spiral tendency is to growth.

175 GOETHEANUM: World Center of Anthroposophy, Dornach, Switzerland.

176 PROJECTIVE GEOMETRY: see note to page 43.

177 F. CAPRA: *The Tao of Physics*, Chapters 12 and 18

PLATO'S *TIMAIOS*: Chapter 33

179 PYRAMID: *But we value, as consequence of the correct and also probable opinion, the body that took on the shape of a pyramid, as the basic part and seed of the fire* ... Plato, *Timaios*, Chapter 56 (*pyr* = fire)

INTERIOR SPACE: We consider the step from the abstract space towards the living fabric of time and space. To which extent can this fabric, reality, be calculated by abstract equations? In his answering of questions to the lecture about *Anthroposophy and Agnosticism* (The Hague, April 12, 1922), Rudolf Steiner pointed out the necessity to expand the mathematical consciousness by supersensible knowledge. — It seems to me that the "vault" of a pyramid, being the exclusion of earthspace, is an initial access to the transition of dead space into the living one. From there we are led towards the imaginative knowledge of the Greek architects, the inspiration of the builders of the Gothic cathedrals with their inwardly metamorphosed sound space, and towards the intuitive knowledge manifested in the architecture of the first Goetheanum, which Rudolf Steiner had called the *House of the Word*.

181 DEEDS AND SUFFERINGS: *The colours are deeds of the light, deeds and sufferings*. Goethe, *Theory of Colours*, Preface.

194 PLANETARY FORCES: The tracing of formative forces in food, water, blood, etc., their quality and their changes during special planetary constellations, encompasses an important field of anthroposophically oriented research. This includes such methods as the measurement of wheat sprouts, paper chromatography, copper chloride crystallization, and the drop-picture method. pioneering publications:

Lili Kolisko, *Sternenwirken in Erdenstoffen* (Goetheanum Dornach, Switzerland, 1932) and: *Agriculture of Tomorrow* (1943)

Ehrenfried Pfeiffer, *Sensitive Crystallization Processes* (Anthroposophic Press, Spring Valley, NY, 1936)

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194 PHYSIOLOGICALLY ACTIVE RADIATION: Modern astrophysics has registered with its devices "stellar objects" of enormous dimensions. It has discovered radiations most diverse in nature, ranging from the spectrum of radio waves (quasars) to "extremely penetrating" cosmic rays. What does the totality of cosmic radiance mean for earthly life? Is it wisdom, strength, life which is streaming to us, or weakest remnants of gigantic explosions? The physical theories of the sunlight offer no explanation for its biological and psychological effects. Similarly enigmatic are the effects the moon exerts on the human emotional life and the relationship of the moon phases to the female cycle. The ancient cultures revered the life-giving planetary forces, on which also the medicine of former times was based (a heritage of that wisdom is the name of the god of healing, Mercury, also meaning the planet and the metal). In our time the physiological activities of earth radiation are often discussed, among those the physically unexplained phenomena of dowsing. Such facts and the observation of radiation emitted from living organisms, be it from dividing cells or even from activities of consciousness, point towards the presence of radiation which is alive.

About the Author:

Bertram von Zabern, M.D. practices as an anthroposophically oriented family physician and psychiatrist. Since 1969 he and his wife Barbara, and their three sons, have resided in the United States. Grown up in Germany, Dr. von Zabern had met George Adams, Ernst Lehrs, Theodor Schwenk, Karl König and other authors not named in this book, who became a guiding influence in his striving. The book "Organic Physics" took form through years of search for the path of knowledge set forth by Rudolf Steiner and its consequences for scientific thinking.