

## 16 'Time' in the Development of the Earth

In the previous chapters nothing has been said about a factor that is of great importance in modern geology, namely – time.

Human thought has derived its measure of time from the circling of the Earth round the Sun, of the Moon round the Earth and the course of the Sun through the zodiac. The fact that the regular repetitions of these motions, through thousands of years back to the earliest known civilisations, tally with our present-day calculations, has led, with some justification, to the idea that these familiar rhythms of time – years, months, weeks, days and hours – hold good for millions of years before and after the present time.

However, besides this perfectly logical conclusion, there is another equally valid, namely, that all repetitive occurrences point to something living, developing, ever-renewing itself. In contrast, the mineral kingdom – crystals, ores and rocks – which is cast off from life, presupposes duration – a tendency to persist in its form. This persistence is to some extent an illusion, for, as we have seen, in weathering and dissolution mineral material can be led back into the stream of life. On closer investigation, as we shall endeavour to show towards the end of this chapter, this 'duration' of the mineral is part of a far greater rhythm than is usually imagined. There is nothing really dead in the world, only varying cycles of becoming, existing and passing away.

Nonetheless we can say as regards the present age: Life exists in 'time' and what falls out of life exists in 'duration'. Strangely enough though, even in the rhythms of our time there is an element of duration in so far as the recurring of these rhythms is calculable. Yet ultimately, all rhythms of anything that is alive are incalculable.

From the fact that what we call 'time' – determined by the relation of the Earth to the surrounding stars – has a certain periodicity, it follows that all the participants in the rhythmic phenomena stand in a living relationship to each other, i.e. they must be themselves living entities.

All living beings are the result of a development from the past into the future, and have, in the early stages of their existence, different rhythms of growth from those in middle and later life. One has but to compare the pulse and breathing of a baby with that of an adult and of an old person.

As we have seen the Earth has passed through stages of a development arising from creative deeds of spiritual beings. These stages took their course in a cosmos which did not have the settled state of our present world. To enable the present order of our solar system to arise, one by one the planets and finally the Sun and Moon had to separate from the developing Earth (which included man and the emerging kingdoms of nature). Thus, up to the separation of the Moon, 'time' could not be reckoned in our present years since the Moon as a heavenly body was not yet incorporated in the system. Only after this event could our planetary system begin to assume its present order and rhythms including its relation to the zodiac. Between the separation of the Moon and the attainment of the present calculable periods of revolutions, time periods approximated more and more to our present years; but they are nevertheless not to be reckoned in exact years.

In this connection Rudolf Steiner repeatedly observed that vital turning points in evolution, such as when 'time' in the modern sense of calculable rhythms began, are always 'connected with certain positions of the heavenly bodies' (lecture, 31.12.1911)\*. Naturally such constellations could only occur after the Sun had separated from the Earth and begun its course through the zodiac. A predictable and exact path was however not achieved immediately after the separation of the Sun. One can say it took thousands and thousands of years (though not measured in years, since they did not exist) till day and night periods, and therewith approximate yearly rhythms, harmonised. To complete the organic process towards calculable 'time' the Moon had to separate from the Earth and start on its own orbit, exerting its influence from outside.

For those interested in the astronomical aspect we recommend E. Vreede's 'Anthroposophie und Astronomie' (Freiburg/Br. 1954).† This work, which elaborates Rudolf Steiner's findings, deals with the

\**The World of the Senses and the World of the Spirit.*

†Translated as *Astronomical letters 1928–30* and privately duplicated.

precession of the equinoxes, aphelion and perihelion, variations in the eccentricity of the Earth's orbit, obliquity of the ecliptic (angle of the Earth's axis) etc. From this it appears that in the 20th millenium B.C. the 'time' began when it became possible to reckon time in years in a universe now moving according to mechanical laws. This point in time is approximately the middle of the Atlantean epoch and therefore of the Earth evolution. Some 4000 years later i.e. in the 16th millenium B.C. the Ice Age began. This period of the Atlantean development was one of extraordinary climatic variations alternating between widespread glaciation and almost subtropical conditions. What occurred is not only due to the constellations (planetary aspects) we spoke of but also connected with the development of humanity. It is only a few thousand years since man walked the Earth in his present form. The prehomnids which have been found in all continents were creatures whose forms hardened too early, but they have nothing to do with that part of humanity which held back the solidifying of their bodies until they could become apt vehicles for souls gifted with self-awareness.

The climatic alternations were the instruments of creation either to school man or to wipe him out if too weak.

During the Ice Age not only were the climatic zones reorganised but the atmosphere also underwent a complete change. In his book *Cosmic Memory* Rudolf Steiner describes how the Atlantean atmosphere contained far more water than today – the air was 'thicker' and the water 'thinner' resulting in a completely different interplay of the two elements. This produced the misty land of North Atlantis, the climate of which was decisive for the development of the white races. In nordic mythology North Atlantis appears as 'Niflheim' (home of mist) and the warmer Southern Atlantis as 'Muspelheim'. The misty land of Atlantis did not know the rainbow because the Sun could not penetrate the thick mist. Not until the Flood of the 10th millenium B.C. and the end of the Ice Age did water in masses pour down from the atmosphere, the sky clear and the first rainbow appear as recorded in the Bible.

From this it follows that there are certain limits to the validity of our calculations of time. When one observes natural phenomena such as the depositing of mud and sand in lakes, river estuaries or bays – or even radioactive decay – it is most important to be aware

of the limits of the duration of our time scale if one is not to fall into the error of projecting the laws of the now aging Earth into the time when the young Earth was coming into being.

It would be as if a scientist, after noting the pulse and respiratory rhythm of an adult throughout one year, would proceed to make a graph and projecting the curve deduce what his pulse and respiration would have been 300 years previously and would be 300 years hence. The observations of the scientist are unquestionably accurate and his calculations equally so, but the pulse and breathing of the man do not continue for 600 years.

It is the same thing as when astronomers, basing their calculations on present-day slight changes in the precession of the equinoxes, the angle of the Earth's axis, aphelion and perihelion, which undoubtedly hold good for 25,000 to 30,000 years, project these rhythms without limits into the past and future, and therefore reach false conclusions.

In this way calculations have been made which go back 900,000 years and produce a curve of the intensity of solar radiation. In the geological field it was possible to trace a corresponding series of glacial deposits for part of this time, which showed a remarkable parallelism. The parallelism is not questioned; only whether it can be measured in years.

Another example is reckoning the age of the Earth from the present-day rate of decay of radioactive elements. These calculations are based on the supposition that the decay of radioactive elements 'began' simultaneously with the formation of these elements in the cosmic process of solidification. Therefore, since the quantities of the end products of decay in a given time are calculable, one can determine how 'old' a particular mineral is and thus how old the whole Earth must be. This results in ages varying from 200 million years for a uranium pitchblende from Joachimstal in Bohemia to 2,600 millions for a monazite from a Rhodesian pegmatite. Equally tremendous differences in the rate of decay of radioactive elements in a given time occur when calculations are based on contemporary phenomena. In this way one obtains the radioactive half-life i.e. the time taken for the number of atoms of a particular substance to be reduced by half. These times range from millions of years in the case

of uranium and thorium to fractions of a second for radium C, a decomposition product of radium.

An extremely interesting phenomenon in connection with rates of decomposition is that the shorter the life of the radioactive element, the stronger the penetration of the alpha particles. Intensity of radiation stands in an unmistakable relation to time. The questions arise: why is the decay of different radioactive elements so variable in time, why do atoms only decay by stages as they give off energy, and why does this decay not occur all at once? There are no simple answers to these questions as long as one considers *naturally* occurring radioactivity only.

Strange to say, man has been able to control the time factor of radioactive decay and regulate or check the natural process. He has also been able to produce artificial radiation electro-magnetically. Basically the processes have been brought under control by embedding large quantities of small units of pure radioactive substances, such as uranium, in graphite or heavy water.

By contrast, the changes, which take place very slowly in nature owing to the fine distribution of these substances embedded in the rocks, can be tremendously accelerated and enhanced by bringing together large quantities of radioactive material leading to the catastrophic chain reaction.

Thus on the one hand we have the principle of the atomic reactor producing energy from controlled decay and on the other hand the atomic bomb.

The intensity of decay depends on the concentration of the mass. The extremely slow, natural process of transformation of uranium 238 into plutonium 239 can be either directed to the production of energy in an optimum of time within the atomic reactor, or it can be made to take place almost instantaneously in a fraction of a second in the atomic bomb.

A small quantity such as 200 grams of uranium 235 or plutonium 239 is harmless, but if it is increased to several kilograms (about the size of a coconut) the chain reaction sets in which leads to detonation. In practice this reaction is triggered off by bringing together two hemispheres of uranium 235 or plutonium 239. Thus it is clear that there exists a relation between the *weight* of a pure radioactive substance and the *time* it takes to decay.

Since pure substances do not occur in nature, the intensification which can be obtained only from pure uranium or plutonium will never take place. For rapid disintegration a relatively pure radioactive substance is necessary, so that little of the radiation connected with the formation of neutrons may be diverted by being absorbed into foreign stable material. Since in nature these substances do not occur in a pure state, such violent reactions will never take place.

It is conceivable however that natural radioactivity has not always existed at the same intensity as today. The rate of decay of certain elements may have increased during the passage of time and not maintained a steady course from time immemorial. This may appear to be incompatible with the presence of lead and helium in radioactive minerals since these are presumed to be the stable end-products of decay as observable today. This seems to be borne out by the different atomic weight of this lead compared with lead ore found far removed from any radioactivity. It could however equally well be that the ubiquitous helium and the lead were always present in these minerals. Thus it is possible that radioactivity is not of the great age generally surmised. Errors like this arise from projecting present-day phenomena into the past and the future.

## 17 *The Earth as Seed of a New World*

The solid element of our planet Earth – the rocks – appears to us as a realm apparently completely at rest and no longer in the process of becoming. The rocky summits of mountains have remained almost unchanged for thousands of years, although in further millenia weathering will reduce the created world to dust. The weathering is due to the elements from which life unfolds – water, air and heat. Life as revealed in the higher kingdoms of nature (plants, animals and man) has nothing of the quiet and settled state of the rocks. It pulsates in the plant between seed and fruit, in the animal between birth and death and leads man beyond birth and death to find his way to his spiritual origin at a higher stage of existence.

The time during which the rocks arose came to an end thousands of years ago. Today the stage of life of the Earth is comparable to a ripe seed which has fallen to the ground and rests in the winter soil awaiting germination. This present stage is best expressed in such imagery taken from the plant world, for the plant seed is a completed stage which can lie dormant for shorter or longer periods. It is also something hardened and mineralised and contains only a minimum of life. Ripening is a mineralising microcosmic process which corresponds to the macrocosmic process of crystallising and hardening of the world of rocks. The hardening of the seed, like the hardening of the rocks, is the unavoidable pre-requisite for the emergence of a new plant or of a 'new Earth'.

What takes place when a seed germinates? Water, air and warmth act upon the hardened seed breaking down its substances into non-organic substances. Only after this dissolution and reducing to chaos, can the constructive and revivifying formative forces of the plant take hold and call forth the seedling.

In one of his last 'Letters to Members'\* in January 1925, Rudolf

\*Published as *The Michael Mystery* 1956

Steiner posed the question: *What is the Earth, in reality, in the macrocosm?* His answer is that spiritual research reveals that the original state of the macrocosm was extraordinarily full of life which gradually died. The macrocosm became more and more subject to calculable laws. The life that has died out of the macrocosm has become microcosmic and is to be found everywhere where seeds germinate and embryos develop in nature.

The present Earth, with its kingdoms of nature and man, developed from the process of dying. The dying of the macrocosm was the necessary condition for the development of man as a being conscious of ego-hood. Through these processes man and all nature carry something germinal into the future.

At the end of the above letter to members Rudolf Steiner calls the Earth 'the embryonic beginning of a new-arising cosmos.' In the microcosmic life of the kingdoms of nature there is today a super-abundance of seeds and eggs which perish and one may well ask what becomes of these lost forces. According to Rudolf Steiner the superfluous seed forces of the plant world provide the *substance* for a new image of an ordered macrocosm. The superfluous forces of the mineral world carry the forces from the plants to their allotted places in the macrocosm. The super-abundant germinal forces in the animal world act in such a way that all that is carried out from the plant world by the mineral forces into the universe is held together in a sphere (a globe) so as to present the aspect of a macrocosm rounded in on all sides and self-contained.

Here Rudolf Steiner points unequivocally to germinal forces in the mineral kingdom. Where are we to find these if we look deeper into nature in the light of spiritual cosmology? We have seen that all the rocks of the Earth initially arose from tremendous plant and animal life-processes. These were predominantly life-processes of the mineral-plant and the plant-animal. This can be recognised by the fact that over 90% of the rock mass is composed of silica minerals and only about 0.2% consists of calcium i.e. animal residues. Thus rocks are predominantly formed from vegetative life-processes. The young limestone strata are but a thin skin or shell patchily covering the Earth.

Everything resulting from dying vegetation contributes to a new

life. This applies not only to seeds but also to the fallen leaves and in fact to the whole plant as it withers and dies. The seed can become a new plant or it can, together with the rest of the plant, rot and be absorbed into the living humus of the soil. Under natural conditions the dying plant always contributes something towards the maintenance of the life in the soil. The germinal nature of this decaying process is not obvious and is only revealed in the formation of humus when the plant residues are united with the minerals of the earth. At first the plant tends to dry out and harden and then it disintegrates and provides the material for the activities of lower organisms. The resulting substances resemble inorganic matter without actually becoming mineral. These processes resemble fundamentally what happens when a seed is formed and, after the winter's rest, proceeds to germinate. As regards the substances present, there are of course great differences, but the *processes* are closely related.

When one transposes these ripening and dying processes of the plant to the macrocosmic scale of the whole Earth one approaches the idea of the birth of the rocks. Silica then played a similar role to carbon in the plant today.

The process of rock formation came to an end about the middle of Atlantis – some 15,000 years ago according to Rudolf Steiner (lectures to the workmen 17.2.1923). Rocks at that time were not so hardened as they are today. The hardening process continued for many thousands of years. Up to the last millenium B.C. enormous buildings were erected by many different peoples using crystalline rocks which today are excessively hard. None of these peoples were acquainted with iron or steel, yet the blocks of stone were dressed with such precision that one cannot insert a knife blade into the mortarless joints. This suggests that the rocks were not so hard in those days.

Even today it is known that freshly-mined granite, sandstone, slate and limestone are softer and can be more accurately dressed than the same rocks after exposure to the air for some time. Air and warmth dry out the rock and often cause chemical changes. One of the most striking examples of this hardening process today is the emerald. In some localities these gemstones are found embedded in soft mica-schists. If one extracts them one can find that – in spite

of their great beauty and transparency – they are so soft that one can crush them to a damp powder between the fingers. These soft crystals must be handled very carefully and must be kept for some weeks in a closed wooden box to dry out slowly. They then become as hard as rock crystal. This is why most emeralds show a network of fine haircracks.

The hardening of rocks is not a continuous process. It is alternating and cumulative. In one of his lectures to the workmen (20.9.1922) Rudolf Steiner said that the hardening began after the separation of the Moon in Lemurian times. In certain areas the Earth solidified to the density of a horse's hoof and after a while became softer again. The hardening then began again in another area and so on. In a later lecture (17.2.23) he described this rhythmic process from a different aspect, showing how the condition of the Earth is dependent on the course of the Sun through the zodiac. Thus 25,920 years ago (one platonian year) the Earth was in a somewhat similar condition to that of the rocks today. Then as now the Sun stood in the sign of Pisces at the vernal equinox. This coincided with the end of Lemuria. The alternating processes of hardening and softening which set in after the separation of the Moon had, by the end of the Lemurian time, led to a condition which can be compared with that of today. In the same lecture of 17.2.1923, we are told that in between, when the Sun (at the vernal equinox) stood in Libra, the Earth became again soft and pliable and was like a living plant. That was the time, about 15,000 years ago, which we mentioned as the end of the time when new rock arose. From this time on began the hardening which has reached its peak in our time; in fact has already passed it. At the end of the current platonian world year (extending from the vernal equinox in Libra about 15,000 years ago to its return to Libra in about 11,000 years) the Earth will again be in a living plant-like condition.

From all this it becomes clear that the present mineral state of the rocks only exists within one platonian world year. At the beginning of this world year when the vernal equinox was in Libra there was a balance between the fluid and solid states of the rocks. The hardening process has not completely penetrated the interior of the Earth even now, as we have seen by the effect of air on rocks when brought to the surface.

Before the rocks became so hard and dry that the elements of life – warmth, air and water – could no longer affect them, disintegration set in through weathering and other destructive forces. Natural radio activity is of course one of these – the self-disintegration of the densest materials of the Earth. Radioactivity has even the power to reverse crystallisation and transform crystalline materials into gel-like substance (see Chapter 11). We are living on an Earth that is already on the way to the time when the vernal equinox will again be in Libra and the Earth will be in a state of balance as it was 15,000 years ago.

Mineral existence is therefore only a transitional stage. It is not a state of complete death but is a prolonged stage of subdued life which once again will awaken to full force, but transformed. We must now return to our comparison with the dormant plant seed.

In the letter to the members previously quoted, Rudolf Steiner has emphasised the significance of the surplus germinating power in the kingdoms of nature. What flows out from the plant world provides, in a sense, the material for a new-arising picture of the macrocosm i.e. the future Earth. What comes from the plant will be conveyed to the appropriate place and moulded by the surplus forces of the minerals. And what flows out as surplus reproductive forces from the animal kingdom acts on what has gone out from the mineral and plant kingdoms and forms it to a sphere, rounding it and holding it together so that it presents the picture of a self-contained macrocosm. Rudolf Steiner pointed here to a macrocosmic law which throws light on many natural phenomena. It reveals the inner meaning of the interaction of the three kingdoms of nature. What is described as the working of the forces of these kingdoms of nature for the future of the macrocosm must also find its reflection in the microcosm. One may recall the old hermetic saying: 'As above so below'.

If one accepts this law one may well ask where it is manifested in the world of the smallest entities. Here the scientist's mind turns towards the manifold world of symbioses, commensalism and other intimate relationships which exist between the three kingdoms of nature – a world full of puzzles, whose laws can be stated but not explained.

There is a fundamental process in which the harmonious inter-

action of the three kingdoms of nature follows the macrocosmic law and can be seen reflected microcosmically. This is humus formation – the living soil in which plants can grow and which supports the higher forms of life. We have described elsewhere that this humus formation is a transformed process from the past (Chapter 4). Here it can be shown how, from another aspect, this process corresponds to the macrocosmic law.

We pointed out that everything proceeding from the dying plant bears something of a possibility of future life within it. One can consider it as surplus germinating power. All that withers and dies has the potential of taking part in germinating life. If one burns the plant remains, these potential forces unite with the picture of the new macrocosm. If, however, one composts them with soil as described by Rudolf Steiner in his *Agricultural Course*, the surplus forces of the plants are united with the forces proceeding from the disintegrating minerals. These forces somewhat resemble what takes place in germination. What finally results from the complete breakdown of mineral substance can be seen in the cloudy water of our streams and rivers after heavy rain or the melting of snow. The breakdown into fine particles also takes place continually in undisturbed soil through the excretions of plant roots. Something arises like a sort of mineral milk. In this substance new minerals are formed which however do not crystallise but remain in a state like curdled milk. This 'jelly' is the bearer of the above mentioned potential-germinative forces of the mineral. This strange substance would 'like' to become crystalline, but remains in this state and is to be found in the soil together with the humus from plant residues. It has a strange attraction for, and unites with, the organic part of humus.

When the minerals take hold of the plant substances in this way, a certain stability ensues which was not present in the individual substances while they were separate. Thus what comes from the plant 'is carried to its appointed place'.

There is however a third process. The 'certain stability' implies something incomplete, not yet finished. To bind this into a stable humus, the animal world must take part. The mineral-vegetable material is taken in and digested by certain lower animals. They are either true insect larvae or animals which remain throughout

their lives at a larval (germinal) stage like the earthworm. In the digestive processes of these animals the mineral-vegetable substance is bound together and rounded off into a stable material by the co-operation of the germinative growth forces of the three kingdoms of nature, something quite new is formed which is the foundation of life for the whole Earth. Already here on Earth these forces work into the future.

If one observes these formative processes of the living soil and compares them with the picture of the macrocosmic process of which Rudolf Steiner speaks, it is not difficult to recognise the macrocosmic law which underlies the maintenance of life on the earth.

Thus even the mineral state appears as all-embracing embryonal force for the future just as much as the other kingdoms of nature. Man, however, is the 'Salt of the Earth'; he is the guardian of all the germinative forces of the Earth. It is given to him to work hand in hand with the creators of the world for the future of the Earth. From a spiritual knowledge of the microcosmos and the macrocosmos he will learn to treat the Earth as do the creative forces of plant growth, which every spring enkindle anew the microcosmic salt process in root formation from which the new plant can grow. Then, from man's husbanding of the Earth, a new Earth can arise in the future.

## Table of Geological Formations

These tables, grouping the rocks into 12 sedimentary and 7 igneous formations, were made by Rudolf Steiner in 1890 when collaborating in the production of *Pierers Lexikon*, edited by J. Kürschner. It is reproduced from the *Literarischen Frühwerk* Vol. IV, Book 19, Dornach 1941.

(Additions by the author are in italics.)

The translators have omitted the names of a few minor local German series, unfamiliar to English-speaking readers.

### A. SEDIMENTARY

#### V Anthropozoic or Recent

- |                 |  |   |
|-----------------|--|---|
| 12. Quarternary | b) Alluvium—marine and freshwater            | 3 Large mammals including mammoth, cave bear, primitive man |
|                 | a) Diluvium—glacial and periglacial deposits |   |

#### IV Caenozoic

- |   |  |  |
|---|--|--|
| 11. Neogene ( <i>Pliocene</i><br><i>Miocene brown coal, limestone, salt, gypsum</i> ) | c) Freshwater deposits<br>b) Brackish water deposits<br>a) Mediterranean marine deposits | 2 Large mammals including mastodon, dino-therium, aceratherium, apes, giant lizards, palm, fig, elm, birch |
| 10. Palaeogene ( <i>Oligocene &amp; Eocene basalt, oil</i> )                          | b) limestones, sandstones, clays and marls   | 1 Large mammals including palaeotherium, nummulites, fucoids   |