

THE FOUR ETHERS

Nick Thomas

Rudolf Steiner referred to the existence of four ethers: the warmth, light, chemical and life ethers. A different and hopefully complementary approach to this question will be presented here from what has been published elsewhere. This will rely to start with upon the one faculty of clairvoyance we all possess: the ability to think about thinking. One observation we can immediately make about thinking is that it is an organising activity. When I think about an unfamiliar subject I penetrate it by organising it in my own way, as often the way an author presents a subject is difficult just because his way of thought differs from mine. If I have to organise an event such as a conference I have to think to do so. The history of science testifies to the need for humankind to find order in the world around. A second observation about thinking is that it may organise macroscopically or microscopically. It can be interesting to observe (e.g. in planning meetings!) how some people are mostly concerned with the big picture, the overall view, and find any insistence on detail irritating, while others can lose sight of the wholeness in their pursuit of the minutiae.

The idea that thinking is an organising agent can be carried further in our study of the etheric forces. Analytical thinking solves its problems by splitting things up into smaller manageable units. But we do not think about everything in that way. Sometimes we embrace warmly an idea, sometimes we try to relate an idea to many others, sometimes we coldly repel an idea. Official procedures that we must contend with can have that effect on us! We can think of the different ways we organise things:

Grouping: or classifying things based on concepts

Sorting: or ordering based on numbers or an index

Sequencing: based on the concept of time

Arranging: in space

Selecting: according to a concept

Specialisation: according to special characteristics or capacities

Chaoticising: the converse of organising, but logically related to it

In the mineral world of crystals we see a static organisation which is only changed by outside forces and agents. Plants on the other hand organise themselves from within, for the same external forces of wind, sun and soil produce quite different forms from different seeds. Their position can only change by (catastrophic) outer action. Animals can move about, and are evidently organised from within more compactly as it were: a clear unity of organisation with quite definite boundaries is apparent in contrast to much plant growth which can be ever-expansive. The inner organisation of the feeling life is clear in animals. With human beings there is a further inwardness where the organising activity itself comes to manifestation in consciousness. In polar contrast to the minerals the environment is changed. The tendency in this direction individualises, the plants tending to have a large scale effect (c.f. Gaia hypothesis), the animals adapt species-wise, build nests, damn rivers etc. but still need an ecological niche outside which they may perish, whereas human beings act in a very local way to suit their ego requirements, and rise above ecological niches to a remarkable degree.

We see here two polarities: organisation from outside and organisation from within.

In our thinking we can conceive of holistic or macroscopic organisation, and polar opposite to this microscopic organisation. We can see an example of macroscopic organisation in for instance a cumulus cloud which has a well defined overall shape but which is a turbulent chaos inside. A plant is organised as a whole into

various organs such as the leaves, peduncle, calyx, pistil, stamen and so on. Consider ants: if you watch individual ants they behave quite erratically, going this way and that, but overall they achieve highly organised tasks. A macroscopic organisation is quite evident. Bees too provide a remarkable example of this. Think of a beautifully formed crystal, where again it is organised as a whole. Light too is conceived to be chaotic microscopically, for instance the polarization and coherence are random or chaotic in normal circumstances, whereas it behaves remarkably holistically, filling a whole space fairly uniformly, and behaving in well ordered ways when passed through lenses or reflected off mirrors.

We may contrast this with a chemical reaction. Here we see very definite organisation taking place microscopically determining the compound produced, but the overall shape of the product need not be at all regular. The growth of bacteria in a nutritive environment, where the overall form is not organised, is another example; but microscopically much organisation takes place to produce an exponentially increasing number of cells.

Let us return to the plant or any living thing: it is clearly highly organised both at the macroscopic and the microscopic level, for the chemistry and cellular organisation must support the action of the whole form and its various organs. Indeed we see a veritable symbiosis between the two. Here "organisation" comes into its own truly, for one of the principles of organisation listed above was specialisation which is a characteristic of the organs of living beings. But, they are all very essentially part of the whole, unlike a machine which is only abstractly a whole; it contains no wholeness-seeking principle in general.

What about the last category listed: chaoticising? This is much more characteristic of warmth. It disorganises both macro- and microscopically.

Thus we can make a table of all this:

<u>Paradigm</u>	<u>Macroscopic</u>	<u>Microscopic</u>
life	yes	yes
chemistry	no	yes
light	yes	no
warmth	no	no

We recover in this way four modes of organisation, which we relate to the etheric forces. Rudolf Steiner spoke about four ethers: the life, chemical, warmth and light ethers. He spoke too of four kinds of nature spirits (Ref. 1) which comprise the etheric body of the earth: the gnomes which push the plants up from under the ground, working with the life ether; the undines which are the master chemists and work more in the watery realm; the sylphs which work more in the air and light with the archetype of the whole plant, and the salamanders which work in the warmth of fertilisation and of ripening. It is most interesting how these spirits are described by spiritual research, for it gives us an important clue about the ethers. The gnomes work out of hate and fear, for they hate the earth as too close a connection with it threatens them with having to assume the form of frogs or toads. The undines too work out of antipathy for the fish form, although not to the same degree as the gnomes hate the frogs. On the other hand the sylphs are attracted to birds and yearn for their form, even experiencing something of an ego experience through their relation to birds. The salamanders too work out of love for butterflies and the world of insects. Thus we see the life and chemical ethers more concerned with the contractive force of hate and antipathy, while the light and warmth ethers are related more to the expansive force of sympathy and love.

LIGHT ETHER

As we have seen light ether is concerned more with a macroscopic organising force. It is at once expansive and macroscopically differentiating. What do we mean by "macroscopically organising"? First let us look again at the picture modern physics has of light. It is conceived as being expansive in the sense that it propagates from its source. Secondly in some fundamental way it is chaotic; normally light is neither polarized nor coherent. What phenomena give rise to the idea of coherence? Under special conditions so-called interference patterns can be obtained, e.g. light passed through two close parallel slits produces dark and light stripes on a screen. But this has to be done with one source of light; if separate sources are each passed through a separate slit and then combined on a screen, no such pattern arises. The picture behind the process is that light waves fall on the screen from each slit, and these may either be in phase in which case we have a light stripe, or of opposite phase in which case we have a dark one. But, the light from the two slits must consist of waves that are consistently related in phase if this is to work. Such light is said to be coherent. In other words it has to be organised microscopically as well, and if so darkness can be revealed. This is very instructive. Usually light is not coherent, and so the light and dark bands do not arise. So we see from this phenomenon that a rhythmic light and dark structure is latent as it were if the light is microscopically organised. This relates to the chemical ether which works in the darkness of matter.

Another aspect concerns polarization, for it is possible for light to behave as though its component waves all vibrate in the same direction. Polaroid sun glasses depend upon this phenomenon. If one of two calcite crystals or two pieces of polaroid is rotated in relation to the other then the light transmitted through them is progressively darkened. Again we see darkness appearing when light is organised microscopically. Normally light exhibits no such effect, but behaves as though composed of randomly polarized wave trains. In both these cases - coherence and polarization - we are concerned with the microscopic properties of light. It is difficult to express these things in full conformity with Rudolf Steiner's findings that polarization has nothing to do with the light itself, but rather with the effect of substance upon substance which is revealed by the light (Ref. 10). However, it will also be clear that polarization and coherence only come into consideration when light interacts with matter.

Light behaves in a well ordered way macroscopically. In refraction through lenses and prisms, and reflection off mirrors, we find lawful behaviour. It behaves so as to conserve images intact, even if those images are metamorphosed by the lenses and mirrors. In experiments with prisms we find light and darkness interacting to produce colour, which again is conceived as differentiating the light into different frequencies or colours. A further organisation is introduced, so that coloured light may be seen again as containing darkness in some way. The necessity to think in terms of frequency only arises with coloured light, and more generally numbers such as frequency, polarization angle, wavelength and phase only arise when light is microscopically organised, incorporating darkness. Neither polarization nor coherence are concerned with images as such, but rather can destroy them under some circumstances. The image is organised as a whole.

This accords with Rudolf Steiner's description of the action of the Sylphs in the plant world, for they weave in the light and air bringing the image of the archetypal plant to bear. It is interesting to observe how this shows up directly on some leaves, where a basic leaf form has drawn on it a picture of a more complicated leaf (e.g. Marantaceae family). Dr. Bockemuhl shows the results of experiments where a radish is grown in various degrees of light from complete darkness to full light (Ref. 2). Ever greater fineness and differentiation of form are apparent as the light level increases and the true image of the plant is more and more attainable. The leaves show more and more indentation and development away from the rounded cotyledon form. Also colours appear more and more. Finally the actual radish tuber only appears in full light.

There is a constant temptation to see light as "raying" and to speak of light rays. This seems to be reinforced by experiments with lenses and mirrors where the use of rays allows the formation of images to be thought about. But, this only works by referring to point-like aspects: bringing light to a focus, allowing rays to stream out from a point and then be brought back to a point of focus where the image of the initial point is formed. In physics there are two pictures of light: one as wave-like and the other as point-like. The wave theory indicates more the planar aspects concerned with whole images, the particle theory more the binding of light with matter. Light falls into matter, and does so in a particle-like way. The wave picture is more concerned with light and matter in external relationship e.g. diffraction effects, contrasted with the absorption of light by metals where the photon concept comes from. The photon is an excellent picture not of light but of fallen light. The photon mediates the electromagnetic force according to physics, in full accord with Steiner's description of electricity as fallen light. Rays only arise truly in this realm, where we conceive of particles streaming in straight lines. Thus we must distinguish phenomena in which light is externally related to matter (e.g. reflection, diffraction, shadows) from those where it passes through matter (e.g. spectrum, refraction, absorption & emission).

CHEMICAL ETHER

Chemical ether is concerned with microscopic organisation as we have seen. Rudolf Steiner indicated that the chemical ether works in chemical synthesis, not analysis (Ref. 3). In other words the bonding of substances is a result of the organising activity of the chemical ether. By microscopic organisation I mean a principle that operates everywhere locally rather than on the wholeness. For example, in a chemical reaction we see the same organisation at work throughout the substances involved, bringing about the same result at each point, but having no particular effect on the whole form of the resulting compound. Other examples are the growth of bacteria in a suitable nutritive environment, or the inconvenient growth of weeds in the garden.

Let us see what picture modern chemistry gives us. Returning to the bonding of substances, several such bonds are known:

1. The hydrogen bond, where hydrogen is bound to a strongly electronegative element. Here an electron is shared between the hydrogen and that element so that the hydrogen acquires a nett positive charge which results in the force of attraction. It is a weak bond.
2. The covalent bond which is 10,000 times stronger, where a pair of electrons is shared by two atoms in a complicated manner. This requires a knowledge of quantum mechanics to understand the picture fully.
3. The electrovalent bond, where an electron is completely transferred between two molecules so that they are attracted together by the resulting electrostatic force.
4. The metallic bond, where in a metal the outer electrons of the atoms form a so-called "electron gas" which leaves the atoms positively charged. Their attraction for the electron gas results in the bond.

The electron is involved in all these bonds, and indeed chemistry is often regarded as the outcome of the electronic structure around the nucleus of atoms. We must be careful about this interpretation, for electricity is fallen light ether, and we might easily then suppose that is the agent of chemical interaction rather than the chemical ether. Rudolf Steiner strongly rejected the idea that matter is electrified, saying that we thereby "demonise" it (Ref. 4). That is not to say that there are no electrical effects in matter, but rather that we need to think more carefully about it. The major assumption we tend to make is that because electrons arise under certain circumstances they are there all the time. Because we can ionize an atom, it is thought always to be

electrified with its positively charged nucleus and the negatively charged electrons in a kind of cloud around that. The logic is the same as if we say that because when I stir water I get a vortex therefore the vortex is always in the water. What lends support to the idea is that experiments consistently reproduce electrons and ions with the same properties, just as when I stir the water I always get a characteristic vortex. However that need not be the case, and when consistently thought through physics does not in fact support the simple view. If we examine what actually determines the chemical properties of elements we find that it resides in two major principles:

1. The energy of particles and radiation cannot assume all possible values, but is quantised into whole number multiples of a basic quantity called the quantum of action. This is quite independent of electrons, but they are subject to it. Thus we find that whole numbers (integers) are essentially involved in the determination of chemical properties, because the electrons are subject to this quantum law in several ways: their energy, their spin, their so-called orbital angular momentum and their magnetic quantum number. (Half integers arise too, but for the moment we may ignore that).
2. Pauli's principle that no two electrons in an atom can be in exactly the same state. They cannot have the same energy, orbital angular momentum, magnetic state and the same spin at once. Again the electrons are subject to this principle, not the cause of it.

We thus see reflected in modern theory something very interesting: a strongly numerical organising principle at work in chemistry. Rudolf Steiner also referred to the chemical ether as the number ether. You see now why I have taken this route: to show how his spiritual research is in fact vindicated by modern research if we think carefully enough about it. Further we can say that the electrons seem to weave substance together within this whole context. Now Rudolf Steiner also described matter as woven light, and here we can see one aspect of this. In particular the covalent bond concept illustrates this. But, that returns us to the question of the continuous existence of electrons in atoms. If we assume that, then matter is woven of fallen light, which Steiner's research showed would imply a "demonising" of matter. If however electrons are conjured into existence in a consistent manner when we perform experiments, but otherwise do not exist in the form of particles - a view quite consistent with modern physics - then we can think of light woven into matter through the agency of the chemical ether. It falls into electricity when we perform experiments. Electronic devices may be viewed as permanently arranged ways of bringing this about to obtain special effects.

The microscopic organising principle of the chemical ether may thus be seen to reside first in numerical ordering. We are reminded here of the views of the School of Pythagoras. We also find rhythmic aspects, for the periodic table of the chemical elements shows that their properties are not random but recur in a rhythmic way according to their position in the table. Thus helium, neon, argon, krypton, xenon and so on are the inert gases, having atomic numbers 2, 10, 18, 36 and 54, all being type 0 elements. Hydrogen, lithium, sodium, potassium, rubidium and so on are all highly reactive metals (hydrogen is technically a metal, even if a gas under normal conditions), being type 1A elements with one valence electron, in contrast to the type 0 elements with all filled electron shells. This rhythmic recurrence of the properties of elements according to their atomic number is again characteristic of the chemical ether. In some sense we see the type 0 elements relatively completely woven of light, while the other types are perhaps incompletely woven and thus more open to react chemically. In the case of light, we noticed that the rhythmic concept of frequency only arises when light becomes coloured. Then darkness is mingled with the light. When it is microscopically organised so as to be coherent, again darkness is implied for then rhythmically placed interference bands may be obtained. The laser is a technical example of chemical and light ethers operating together. Here the microscopic organisation is intense, affecting strongly the macroscopic aspects, so that the light ether seems more to serve the chemical ether. A laser beam approximates closely to a ray, diverging only very slowly, which is quite contrary to the normal quality of light; the expansive quality has been narrowed down to one direction. The involvement of chemical ether with the light ether

introduces rhythm and number, for then we can associate numbers with the colours (the frequencies) and the interference effects bring discreteness and rhythm. Chemical ether is polar to light, being active in the darkness, particularly the darkness of matter.

In the plant we would expect to see the chemical ether active in conjunction with the light ether where forms arise that are rhythmically arranged and show the quality of similar organisation at many localities. We will hardly find these two ethers separate in real life! For example think of the beautiful spiral forms in many flowers such as sun flowers. Here we see many similar forms arranged rhythmically, characteristic of the chemical ether, but in an overall form given by the light ether and, as we shall see, woven by the life ether. Each local form is itself due to the light ether, however; the chemical ether combined with the light results in the local repetition. The actual chemical processes in the plant that support its growth are of course more "pure chemical etheric activity", but we cannot observe them directly, residing as they do in darkness. If we are to observe the effects of the chemical ether, we can only do so with the help of the light.

We can also imagine that strongly local growth, which is only simply organised macroscopically, may result in characteristic forms. In other words where the chemical ether predominates over the light, we would find a certain uniformity overall, but strong local organisation manifesting everywhere the same. If we look at the work of Dr. Bockemuhl where plants were grown in various degrees of light, we find that the leaf forms remain very simple when there is little light. The more the illumination the finer and more differentiated the forms. Now a simple leaf surely illustrates what I mean: it is organised in detail everywhere as "leaf", the chemical activity being complex locally to produce leaf substance; and its overall form is very simple showing a minimum of the image quality of the organising activity of light. We see the typical "half moon shape" pointed to by Dr. Wachsmuth (Ref. 5), but tending in fact to a segment of a logarithmic spiral on the periphery. Careful measurements show that these simple leaf forms fit logarithmic spirals very well. I would not ascribe the so-called half moon shape to the chemical ether as Dr Wachsmuth did, but rather I would see here the effect of light in producing an expansion coupled with rotation, which is a logarithmic spiral, when the chemical ether predominates. Notice that the spiral arises from a fixed ratio between expansion and rotation. Now linear motion is characteristic of the physical, whereas rotation is characteristic of the ether. Rudolf Steiner gave a delightful lecture on this in response to a question from one of the workmen at the Goetheanum (Ref. 6). Rotation is an example in physics and mathematics of a field that imposes local rotation wherever the field operates. Technically a vector field has "curl" if it imposes such an effect. The rotation of a logarithmic spiral may be seen as a local one operating at each point of the periphery, which is a much more "organic" rotation than a simple rigid rotation, say of a wheel. It is then clear that this component of the form comes from a chemical ether activity. So we see the logarithmic spiral arising from a combination of expansion due to the light ether and rotation due to the chemical ether. We may recall that spin or rotation is an essential aspect controlling the chemistry of elements. We only discussed the quantisation of energy and the Pauli exclusion principle above. Now the notion of spin in physics is very elusive in some ways. The spin of the electron was introduced because the conservation of angular momentum could not satisfactorily be accounted for by the imagined orbital angular momentum of the electron round the nucleus. However neither concept is at all clear, for the orbital angular momentum is conceived in analogy with the rotation of a planet round the Sun, yet physics cannot consistently speak of a particle (the electron) in orbit round the nucleus, so what is this momentum? Similarly the electron is not supposed to have any structure, and neither is it strictly a particle when occupying an orbital, so again we wonder what is spinning, and what spin really means in this context? The whole thing is a typical example of metaphysical realism! We can see from the present work that this spin is an aspect of the microscopic organising activity of the chemical ether. Then we do not have to suppose that anything "spins" (as indeed physics recognises) but rather that rotation is locally organised and particles are subject to it when they exist. This can only be sketched here.

So far we have ignored the nucleus of the atom, but we should comment on the rhythmic arrangement of atoms in a crystal lattice as pictured by physics. We have found no reason to suppose that the chemical ether acts to form particles, but only that it imposes numerical and rhythmic order, and causes local spin. It acts everywhere locally. But what do we mean by "everywhere"? Our picture of a crystal is of a regular array of atoms, and the chemical ether acts wherever there is an atom. Thus something other than this ether determines what "everywhere" means. The crystal lattice is in a sense rhythmically organised, and has a wholeness too. We will come to these aspects when we consider the life ether.

LIFE ETHER

We saw that light ether organises holistically in an image forming way, while chemical ether organises microscopically - everywhere in the same way - rather like a field. But we have accounted neither for the picture of the atomic nucleus nor the crystal structure of minerals, nor the emergence of particles. Crystals have aspects which at first sight belong to light ether in their holistic structure and chemical ether in the rhythmic arrangement of the atoms. We must look critically at the notion of atoms, for they are an essential ingredient of modern physics and chemistry. A chemical element has a definite identity, and although its chemical activity is as described before in connection with the chemical ether, the detailed chemical identity is determined by the atomic number of the nucleus. This provides the context within which the chemical ether acts. Now we can apply the same reasoning to atoms as we did to electrons, by challenging the concept that they exist all the time. That experiments are consistent with continuous existence is no proof of it, just as the consistent behaviour of vortices in water whenever it is stirred does not mean that those vortices are there all the time. Indeed modern findings in chemistry indicate that a closer fit to experimental results is obtained when a given structure of atoms in a solid is not assumed at the outset. Clearly, however, the organising activity at work is strong enough to produce consistent results that associate a well defined identity with the element. The nucleus is precipitated always in the same way under given conditions. Now it is also notorious that no one picture of the nucleus is sufficient to explain all its properties. In other words a rigid mechanistic picture has not been found. The most appropriate picture depends on the experiment or phenomenon concerned. This too suggests that the identity is expressed according to the question asked. This mainly affects nuclear physics, and the picture of the nucleus is largely ignored as far as chemical properties are concerned.

We have seen that we may envisage life ether as simultaneously a macroscopic and a microscopic organising activity. This means that both are coordinated, in contrast to the simultaneous but distinct activities of the life and chemical ethers. We could say that the relation between the microscopic and macroscopic is organised by this ether. Thus we might expect this to manifest in an organising activity that acts everywhere locally but not everywhere the same i.e. the local organising activity acts in a macroscopic context, adapting itself from point to point according to the overall context. How does this differ from the chemical ether acting within a context provided by the light ether? The light ether is expansive whereas the life ether acts in a contractive manner; recall the gnomes acting out of hate for the earth. Hate is a contracting, excluding sort of activity. Hate repels. We do not necessarily expect the wholeness involved in the life ether to be expansive, then. We imagine an intensive wholeness rather than an extensive one. Think again of the leaf of a plant. We identified the everywhere similar but local formative activity with the chemical ether and the overall image formative activity with the light ether. But what ensures that rhododendron leaf activity is everywhere locally at work and not pine needle activity? We see the need for another organising principle apart from the light and chemical ethers, for the local organising activity must reflect the whole. Hence the wholeness becomes intensive or microscopic at every point. Neither the light nor chemical ether accomplishes this, but the life ether which is both macro- and microscopically organising. This ensures that the whole image provided by the light ether is individualised everywhere, and in that context the chemical ether acts. In the elements this intensive wholeness gives them their identity, ensuring that every atom appears the same when forced to manifest, and that the

chemistry is consistently working in such a context. The image becomes intensified. Another important feature of the leaf is that it has a definite size. The expansive image-forming of the light ether must be checked, and this is not accomplished by the chemical ether according to our work so far. The contractive activity of the chemical ether acts microscopically whereas here we require a macroscopic contractive activity. This limits the size of the form. But, if the macroscopic activity of the life ether acts contractively in contrast to the expansive macroscopic activity of the light, might we not also expect the microscopic activity of the life ether to be expansive to counterbalance the locally contractive activity of the chemical ether? We see a picture of this in plant growth when we see how the smaller expands i.e. the microscopically organised expands in size. Consider how vegetative growth is imagined to go on unchecked e.g. ivy. This is not the expansion of the light ether which would be the expansion of a whole image, but expansion within, involving repetition of leaf after leaf, swelling and thickening, in short all that shows the plant to be alive! Think of the activity of the gnomes described by Rudolf Steiner: they push the plants up and away from the earth, producing growth upwards. Remember that growth takes place at the tip, new cells always forming there, so that growth is not overall expansive as would be the case if the light ether caused it, but microscopically expansive.

Our concept is now as follows:

Light ether	macroscopic organising and expansion.
Chemical ether	microscopic organising and contraction.
Life ether	macroscopic organising that is contractive opposing the light ether, microscopic organising that is expansive opposing the chemical ether.

We see that the proportion and balance of the whole form which expresses its identity results from the balancing activity of the life ether, weaving and balancing the light and the chemical ethers.

Returning to the crystal we clearly see planar expansive growth and regular organisation. Now crystal growth is not a chemical phenomenon, and we would not expect to find the chemical ether necessarily involved. Yet we see local organisation everywhere the same and macroscopic organisation embodying a beautiful geometric form. Notice first the character of the growth: it is characteristic of light ether expansion i.e. a small form gets larger by addition rather than organically. There is no "healing"; the perfection of the whole form can be marred by external factors which then cannot be rectified later. Yet the geometric image is constantly present and active even if the perfection has been marred. We see typical light ether macroscopic expansiveness in contrast to a life ether microscopic expansiveness which would preserve the integrity of the whole form. On the other hand the microscopic organisation is not chemical, but such as to maintain the integrity of the substance of the crystal, selecting the right element from the solution with which to build the form. The whole form affects the microscopic situation. The life ether is active from without inwards but not the reverse. In other words the cosmic life ether is at work in the crystal. In an organism the life ether is also active from within outwards, for the whole form is affected by local conditions. A poison affects the whole, activating defence mechanisms throughout; a disease in one organ affects the whole organism. In genetics too we see this character at work, for the mutation of a gene affects the whole organism which retains its integrity as a whole even if deformed. The result may be grotesque in some circumstances, and the viability may well be affected, but as far as possible the organisation of the whole remains organically intact. For example, the mutation producing albinism affects the eyesight, the colour of the hair and so on, and while it may have an overall weakening effect, we still have a complete human being. We see no such phenomena in crystal growth.

The life ether is what imparts individual identity, both to elements when we are concerned with the cosmic ether and to living organisms where the life ether is individualised.

WARMTH ETHER

We associate warmth ether with disorganising rather than organising. When a substance is heated it may be able to react chemically where it could not before: the existing ordering may be loosened and a new organising influence be brought to bear instead. This is still physical heat, which Rudolf Steiner distinguishes from soul warmth. Physics does not recognise warmth as a state of matter comparable to the solid, fluid and gaseous states. However, it does recognise what it calls energy, and since Einstein's discoveries this has been seen to be exchangeable with mass. So mass is woven energy in some manner. Rudolf Steiner spoke of matter as woven light (Ref. 7), which is a similar but not identical idea. Physics regards light as a form of energy, and spiritual science discloses that the primal warmth was differentiated into light and air. So the will or energy of heat is refined to produce light. It is not known how energy is bound in the form of mass, so it may well turn out that it is light energy that forms mass. In the theory of relativity mass is also regarded as a momentum in time rather than in space, which may prove a useful picture when reinterpreted. The release of the energy inherent in mass thus involves "turning its momentum through 90 degrees", or changing its dimension. In the Warmth Course (Ref. 10) Rudolf Steiner points to something not dissimilar when he speaks of the release of latent heat. He points to the involvement of a different dimension. Now this involves the weaving of matter, for when a fluid changes to a solid heat is released; hence it gets warmer when it snows.

The warmth ether is the principal bridge between the physical and the etheric; it has a kind of Janus quality for it looks both to the physical and to the etheric and mediates the two (c.f. Ref. 8). What do we mean by physical warmth? How is it different from pure warmth ether? In physical systems we find that heat introduces randomness. The concept of a warm gas is of a random movement of molecules with an average energy related to the temperature, and a pressure determined by the average momentum of the molecules striking the walls of the container. This is problematic if one does not regard a gas as continually consisting of molecules. Certainly spiritual science regards warmth as an independent state, not merely the state of motion of particles. However, what is common is the concept of motion. Physical warmth may be regarded as pure motion in space (not motion of anything). Etheric warmth is not spatial in the same sense, but is more intensive than extensive. A kind of reflection of this lies in the picture in relativity theory of intensive momentum related to time, but there is no exact match because relativity regards time and the three dimensions of space as all qualitatively the same. Rudolf Steiner pointed to the need to distinguish the qualities of the three dimensions of space, not see them as all equivalent, let alone seeing time as equivalent too. So we are pointed back to warmth as coming into and going out of space accompanied by a change in quality; indeed it becomes related to an intensive or counter space in its etheric form, which is qualitatively entirely different from ordinary euclidean space. Another very interesting hint Steiner gave to scientists was that warmth does not "flow" through a body in the phenomenon of the conduction of heat (Ref. 10). Rather we have to see that heat is reflected off matter; reflection is a phenomenon we all know well in relation to light, but here we see him extending it to warmth. However, it is an inner intensive reflection unlike that of light by mirrors which is extensive and macroscopic. We see the microscopic disorganising action of warmth here.

The more macroscopic disorganising action of warmth shows in its tendency to seek a common temperature level; if two bodies of different temperature are in contact then the cooler warms up while the warmer cools down until they reach the same temperature. Thus a thermally organised (differentiated) environment tends to level out. The second law of thermodynamics expresses this tendency, often cited in relation to the so-called heat death of the universe.

Rudolf Steiner describes the action of the salamanders (elemental beings) as mediating warmth ether, especially in connection with phenomena of fructification in the plant world. Here the cosmic warmth is carried into the pollen to enable this. He speaks of the love the fire-spirits have for the bees and insects which have so

much to do with fertilisation. Our own experience of warmth, both inner and outer, is of blissful enabling. We feel cramped when cold, but much freer when warm. This is the positive and formative aspect of what is otherwise a disorganising principle: freeing and enabling. Too rigid a descent into form is prevented, and the necessary extreme contraction into intensive form represented by the seed is freed and released in fructification so that a new expansion is possible. The macroscopic action of warmth is clearly expansive in nature, but what about its microscopic action? We find the life ether acts contractively in its macroscopic action, but expansively microscopically. We might expect a similar reversal for warmth, which would require the microscopic disorganisation to act contractively. We see this in the contractive action of the salamanders in carrying the cosmic warmth into the pollen.

In spiritual science we find four stages of creation; an outpouring of will which gives rise to warmth, then the action of wisdom to bring light and order into the chaotic will, then the introduction of movement, and finally the expression of the result in form. We can trace these stages in our thinking, for we would not think at all without the necessary inner will; then wisdom enters when we start to grasp a thought, an inner movement follows as we shape the result into a final thought form. What can happen next? Spiritual form is shattered! (Ref. 9). There is no other further step. Rudolf Steiner describes matter as arising from such shattered spiritual form. We have to be able to "digest" our own thoughts if we are to remain free of them; in obsessive and compulsive illnesses one can observe how this does not happen properly, and the patient cannot get rid of a thought particularly if it is unpleasant. This inability can arise from metabolic problems, particularly in the digestion. There we find the warmth organisation especially active; indeed highly destructive forces are at work in the digestion of food. Thus we find the warmth of digestion is needed to "digest" our thoughts, to finish with them decisively, to shatter their form again so that we are not compelled by them. Warmth releases again what has become fixed into form, which we see pictured in the way heat is needed to melt a solid or vaporise a fluid. It also provides a context in which we destroy matter through thinking. For the most extreme case of phenomena such as melting and vaporisation is the dematerialising activity of thought so that any initial material basis is expelled and annihilated leaving only unreal pictures. That is what happens in pure thought (Ref. 8). Heat provides the context in which this happens, for heat or warmth provides the means for the soul and spirit to act on the body and vice versa. Warmth is a gate to the soul which leads out of space into time. Here we meet the true heat death reflected in our thermodynamics: we must die in order to enter the soul and spiritual world, either at the end of our life or else in initiation where we die - not physically - but to our lower self. Heat dissolves the form of our thoughts, and in that case also the form of our lower ego. Here we reach the inner significance of the disorganising action of warmth.

THE FORM OF LEAVES

We must stress that the form of a leaf arises from the working together of all the ethers. It seems too simplistic to say that a pointed or triangular form is a result of the light ether, or a rounded form results from the chemical ether. The light ether works expansively in an image forming way, while the chemical ether works contractively all over. Particularly the chemical ether imposes the tendency to rotate, which can be followed up in the phenomena of phyllotaxis. But the life ether works to balance these, checking the contractive tendency of the chemical ether and the expansive tendency of the light ether. We saw that the edges of leaves tend to the logarithmic spiral form. If the expansive tendency of the light ether predominates then the radial growth proceeds quicker than the contractive rotation of the chemical ether, and we get long slender pointed forms such as blades of grass. If the chemical ether predominates the leaf tends to the more circular form we find in the lily. The balance between the two, whether one or the other predominates, depends upon the life ether. Recall now the image formative activity of the light ether, which was so interestingly illustrated by those leaves that have an image drawn on them. But this shows that the image can remain a mere image unless something else intervenes, for the substance has the simple leaf form while the colour has the image form which in other circumstances may be realised substantially. The life ether is necessary to inscribe the image into reality. Thus the life ether may be "informed" by the light ether of the required image or form which then controls the balance between light and chemical ethers to produce it. This it accomplishes by exerting a macroscopic contractive action to balance the expansiveness of the light ether, and a microscopic expansive action to balance the chemical ether. Rudolf Steiner describes how the sylphs dream the form of the plant, but we gather it would remain a mere dream but for the action of the life ether! Thus more complex form arises not merely from the light ether, but from the action of the life ether in conjunction with it. Sometimes we see several simple leaf forms superimposed at rhythmic angles to form one leaf e.g. ivy, maple, plane. We see something like the interference patterns of coherent light, but in the world of the living; a rhythmic alternation of form as light and dark work together. We see a "living rotation", for the angles involved vary not mechanically and equally but livingly as described by a growth or step measure in projective geometry. The serration of leaves can be seen as an extreme of this in one direction, tending toward the simple leaf, and the Horse Chestnut in the other direction where the component leaf forms become separate. The ash leaf represents another development of the latter, but now a linear instead of a rotary contraction is apparent more characteristic of the life ether itself. The oak leaf is an intermediate form for this kind of image as a maple leaf is for the rotary form.

PROGRESSION FROM SIMPLE LEAF SHOWING MACROSCOPIC INFLUENCE OF CHEMICAL ETHER



PROGRESSION FROM SIMPLE LEAF SHOWING MACROSCOPIC INFLUENCE OF LIFE ETHER



If we study the metamorphosis of the leaves of a plant, we can often see more rounded small forms first, expanding to greater differentiation and size and then contracting to small more pointed forms. We recognise the increasing dominance of the light ether in the expansion, characterised both in the increase in size and the greater differentiation of form (as the image it carries is realised), and then in the decreasing size the dominance of the life ether in its macroscopic contractiveness but coupled with a further dominance of the light over the chemical ether in the increasingly more pointed forms. For example the wall lettuce shown by Dr. Bockemuhl in Ref 2. Of course not all metamorphic sequences are like this, for the species of different plants establish different balances between the formative principles through the life ether. Thus the metamorphosis results from the living Idea active in the plant which we can become more conscious of through practising inner imaginative work with such forms. This Idea works through the dynamically changing balancing activity of the life ether.

The microscopic expansiveness of the life ether we also see in the repetition of many small but similar forms which grow locally within the plant. The chemical ether works with the light to differentiate the form rhythmically e.g. in phyllotaxis, but each local expression of the plant (leaf or floret) is often an image of the whole, which betrays the work of the life ether in carrying the image given by the light ether into that local expression. We saw this process in the more complex leaf forms as well where simple leaf forms are combined. It may seem that in some of these, e.g. palmate leaves like that of the Horse Chestnut, the rhythmic aspects are

not microscopic as we would expect for the chemical ether, but relatively large scale. But remember that the life ether may balance this through its microscopic expansive activity so that the rhythmically repetitive activity of the chemical ether appears expanded to visibility in this large scale manner.

We see the strengthening of the life ether as the plant grows and develops, manifest in the ever more detailed forms of the leaves and then the decreasing size until the leaf sequence is complete, and as Goethe put it so beautifully "...steals softly into the calyx". The life ether is immensely powerful, yet it works in the plant without any outer commotion, softly! We see quite a change in the flower. The chemical ether is more powerfully at work in the rotary and rhythmic form, the calyx and corolla being leaf-like but arranged in a circle instead of linearly in many flowers. The stamens too are arranged in a circle round the pistil. The linear action of growth of the life ether is arrested in these forms, and its microscopic expansive activity is in evidence instead in the repetition of the forms of the sepals, petals and anthers each rhythmically organised by the light and chemical ethers. The linear raying form we find in the style and filaments. The macrocosmic contractive activity of the life ether has acted on the light ether, hence the dominance of the chemical ether, but the light ether is now expressed in the expansion of the whole flower from the top of the peduncle and in the beautiful colours. The warmth ether comes microscopically to manifest in the pollen. The metamorphosis from the leaf sequence to the flower has been brought about by an overall change in the balance between the ethers rather than a series of more local changes as in the leaves. Also, it is now more spatial and less temporal, for the leaves appear in their metamorphosis one after another in time, whereas the flower unfolds as a whole. This metamorphosis involves space and time too.

Finally the colour of leaves shows how the light and chemical ethers are balanced. Green is the most neutral colour, which is most generally found. If light predominates over darkness, then we move to the red end of the spectrum. Some leaves are more yellow or red, whereas we do not often find blue leaves. In autumn the colour usually moves towards yellow, orange, red and eventually brown. This shows the diminishing action of the chemical ether, representing darkness. This would imply that after the withdrawal of the life ether the chemical and light ethers act independently. The chemical ether acting only locally results in the destruction of the form, while the light ether dominates in the colour until both also withdraw when the colour turns brown.

Conclusion

Starting from simple observations of our thinking activity concerning its organising function, we have attempted to think to its logical conclusion the consequences of those observations. A possible characterisation of the four ethers resulted which can be followed up in the details of plant forms. This work has been carried further to study sub-nature, in the hope of finding ways to handle radioactive waste and other such problems, but remains at an early stage as yet. Also links with modern chaos theory are evident e.g. in the red spot of Jupiter where an overall form appears in the midst of chaos at the detailed level. This is characteristic of the description of light ether given above. These are ongoing areas of research not yet ready for publication.

References:

1. Steiner: "Man as Symphony of the Creative Word", GA 230,2 Nov 1923.
2. Bockemuhl: "In Partnership with Nature".
3. Steiner: GA 313, 12 Apr 1921.
4. Steiner: GA 220, 28 Jan 1923.
5. Wachsmuth: "Etheric Formative Forces".
6. Steiner: GA 224, 30 May 1923.
7. Steiner: "Manifestations of Karma", GA 120, 27 May 1910.
8. Steiner: "Man Heiroglyph of the Universe", GA 201, 16 May 1920.
9. Steiner: "The World of the Senses and the World of the Spirit"
GA 134, 30 Dec 1911.
10. Steiner: "Warmth Course" (GA 321).