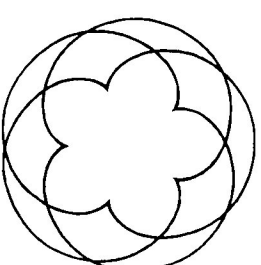


# SCIENCE FORUM



Published by the Science Group of the  
Anthroposophical Society in Great Britain

## No9

(Spring 1993)

S C I E N C E F O R U M is edited by Howard Smith, and is published by the Science Group of the Anthroposophical Society in Great Britain. It aims to publish lectures and other contributions from science conferences organised by the Group, as well as articles, reviews, research reports, correspondence and other items of interest.

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

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E D I T O R I A L

OUTER SPACE OR INNER SPACE?

What is the most important issue in Science at present? What exciting developments are at the leading edge? Not so many years ago, the answer could well have referred to the amazing advances in space technology - the various missions which produce those breathtaking pictures of Saturn's rings, Jupiter's moons, the surface of Mars - beautiful revelations of the cosmos. But what has happened to those dreams of "Man's future in space"? Permanent space-stations, a moon base, manned flights to Mars? They now seem about as real as the recent "discovery" of a planet beyond Pluto - later retracted as a computer error. NASA has just announced a set-back in their time-table for more manned flights... "until the Nation can afford it" - 20 years or more! Has the drive to reach for the stars now past its zenith?

Attention now seems focussed on the nature of man himself; the "Human Genome Project" promises to unravel the ultimate secrets of the human body. The result will be a complete description of the DNA molecule - which should make about as interesting reading as the London telephone directory! However, for those with the technology to "dial" the right code - and modify it - strange and disturbing new vistas open up. The result field of genetic engineering is surely the hottest thing around right now. Together with other life-intervention technologies (abortion, euthanasia, eugenics) it is dynamite - scientifically, politically, and socially.

Already much is possible. The first "gene transplant" has just been given to an 8 month old baby girl suffering from "Total Allergy Syndrome", with as yet unknown results. She has been given a gene in a modified virus which will enable her to make an enzyme (ADA) at present lacking. The "transplant" does not extend to the germ cells, so there will be no change in genetic material transmitted to the next generation - a wise precaution at this early stage. It is hoped that other genetic defects - cystic fibrosis, muscular dystrophy, immune system disorders, maybe even cancer - will also yield to genetic manipulation. Progress is rapid: on average, one new gene is discovered each week. Soon the "Blue-print of Mankind" will be laid bare, and the Language of Life" will be read. Such is the Florida language currently in vogue.

In a remarkable Radio 4 interview in March 1993, Jeremy Rifkin (Director of Washington's Foundation on Economic Trends), warned that we are dealing with the "most powerful technology ever". We have now (or will soon have)

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the power to re-design the genetic blue-print of the human race - with a high chance of error. For the genes which we are so anxious to eliminate may well have desirable recessive traits. Thus, the gene causing sickle-cell anaemia also prevents malaria; while the gene implicated in cyclic fibrosis may cause certain types of cancer. We should not "play God"; rather, we should act as a steward with Nature, offsetting our genetic predisposition as best we can, e.g. through diet. This of course is not done (says Mr. Rifkind) because there is no profit in it!

In reply to all this, Professor John Harris (in the same interview) asserted "our responsibility is to play God; Nature is not doing a good job"! A memorable quote indeed, from a leader in the field.

Unlike Space Technology, which is virtually monopolised by NASA, research in Bio-technology is distributed over many nations. It poses direct and challenging questions on the nature of man; the role of the physical body in serving the destiny of the individual; human freedom; and ethics. As we approach the end of the Millennium, it becomes ever more urgent to be motivated by a more holistic picture of the human being, not a one-sided, purely physical view. We can perhaps be grateful that the new technologies are forcing society at large to an ethical re-evaluation of the purpose of life. One off-shoot of this is the emergence of "pro-life" groups, aggressively opposed to interventions such as abortion. The recent activities of "Rescue America" in London and the deportation of Donald Treshman, points to the intensity of feelings involved. During a radio interview, a representative of the organisation ("Miss O'Kief") claimed that the clinics they were targeting are in fact involved in practical eugenics; they are attempting to create a superior race, just as Hitler did.

Although it would be unwise to attach too much importance to the opinions of a group who use violent means to achieve their ends, we do need to develop new capacities to see beneath the surface of life-manipulating techniques. **Whose interests are they really serving?**

"There is nothing more terrible to behold than ignorance in action"

(Goethe)

#### THE FUTURE OF SCIENCE FORUM

Unfortunately, production has suffered more than a slight hitch. It has been necessary to reduce costs drastically, and I hope that the new format (and the lower price!) are acceptable. Hedley Gange, who has done the bulk of the editorial work since the inception of Science Forum in 1979, has had to retire; a very big "Thank you" Hedley, for all that you have done.

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In order really to serve those working in new directions in science, through articles, reports and vigorous exchange of correspondence, an ideal publication frequency would be, say, 2 or 3 editions per year, and I hope a small production team can be established to work towards that goal. As a first step, the NEXT ISSUE (No. 10) is scheduled for January 1994. Please support this venture with your enthusiasm, and perhaps with manuscripts or correspondence if appropriate.

Howard Smith

#### AN INTRODUCTION TO RHYTHMS IN MAN AND NATURE

Günter Hildebrandt

Rudolf Steiner, when questioned "What is the real nature of life?" answered: "Do study the rhythms!". Without doubt, the rhythmical functional order of the living processes represents a fundamental characteristic, and that in plants, animal, and man.

When considering the physiological and medical aspects of man, one must give particular importance to the factor of time, because since the second half of the last century scientific medicine has almost completely ignored the aspect of rhythm or periodic time regulation of vital processes, their order and temporal structure.

For a long time, scientific medicine concentrated mainly on the spatial and material structures of life, its morphological appearance, and its pathological alterations, up to the ultra-microscopic dimensions. Rhythm, the re-appearance of the similar at similar intervals, as formulated by KLAGES (1944), remained an object of belles lettres and the arts. The spontaneity of life, most clearly seen in its rhythmical variations, was not taken into consideration.

As a result of this narrow development, we find that in enumerating basic criteria of life (form, metabolism, sensitivity, reproduction) many of the present-day biology textbooks fail to mention the important fact that every vital process must take place in certain time structures and rhythmical formations. Without doubt, we have here a field of biology and medicine, in which much development is needed and in which much research has to be done, in spite of the progress which has been made in the past decades in the development of chronobiology and medical rhythm research.

The second reason, however, is that man himself raised a chronobiological problem in the course of his civilizing development. This problem is peculiar to man alone and affords him an exceptional position among all other living creatures - this perspective of time. This specific human problem is the biological conflict, which results from the fact that man has begun to free himself from the time factor, as part of his increasing degrees of freedom of behaviour. In other words, he has disregarded the correlation between his biological, chronobiological order and the geophysical, chronobiological order of his environment. He no longer lives in natural harmony with the daily and yearly rhythmical changes of his environment. Almost 20% of all employees work at night and in shift work, and the results of this situation cause disorders which occupy the attention of the medical world to an increasing extent.

This problem, however, is only a part of a far more extensive question regarding the time relationship to the environmental time order and the dependence of human life upon its environment, where possibilities of variation seem to know no bounds. By means of technical knowledge, man not only can turn night into day, he can also produce whatever temperature he wishes his environment to have, in whatever place, at whatever time. By chemical means he can change wakefulness to sleep, and sleepiness into activity. By means of hormone pills he can, at will, interrupt the menstrual cycle, once believed to be controlled by the Lunar cycle. Finally, he can by means of air travel change the zones of time and season by leaps and bounds. In the majority of cases, our disturbed sense of well-being which results from this interference, indicates that the random disruption of the natural order of our environment is not accepted without resistance by our organism. But where are the boundaries of freedom? This is a question which has become of pressing importance and that not only since man decided to venture into space and to set foot on other planets.

In order to estimate the significance of man's freedom from time, it is necessary to take a closer look at his biological time structure. Under biological rhythm we usually think of only the 24-hour period of day-night rhythm. This, however, is merely a small band within a wide spectrum of rhythmical functions, which one can identify in man's organism (Fig.1).

Were one to group the main types of rhythms according to their period durations, we would find a spectrum ranging from about 1/1000 of a second (1000 Hz) up to years. Expressed in musical terms this would be an extension over 24 (2 x 12) octaves. Important, however, is the question of

whether we are dealing merely with coexistent but unconnected rhythms whose frequencies are determined solely by their specific functions, or whether the temporal order - which is given to each function by its rhythmical structure - has its own inner relationship. In other words, whether it must be seen as a link in the chain of the time organism. As you certainly know, Rudolf Steiner characterized the etheric organisation of man as a time organism (Zeitleib).

First of all, we can see a notable hierarchical gradation among the enumerated functions. In the short wavelengths, we find rhythmical processes of isolated structures, single cells, specific tissues, and single organs (nerve cell action, EBG waves, ciliar movement, and heart beat). In the middle area of the spectrum, we find the rhythms of larger systems (movement, respiration, vascular system, peristalsis etc.). Finally, in the long wavelengths, we find the complex vegetative changes which encompass the whole organism in its daily and annual rhythm, as well as the menstrual cycle, the rhythm of fertility and reproduction. And if we add to these, those rhythms which run over a matter of years, for example sun spots, then we have biological changes which concern whole populations, as seen in the case of mortality rhythm.

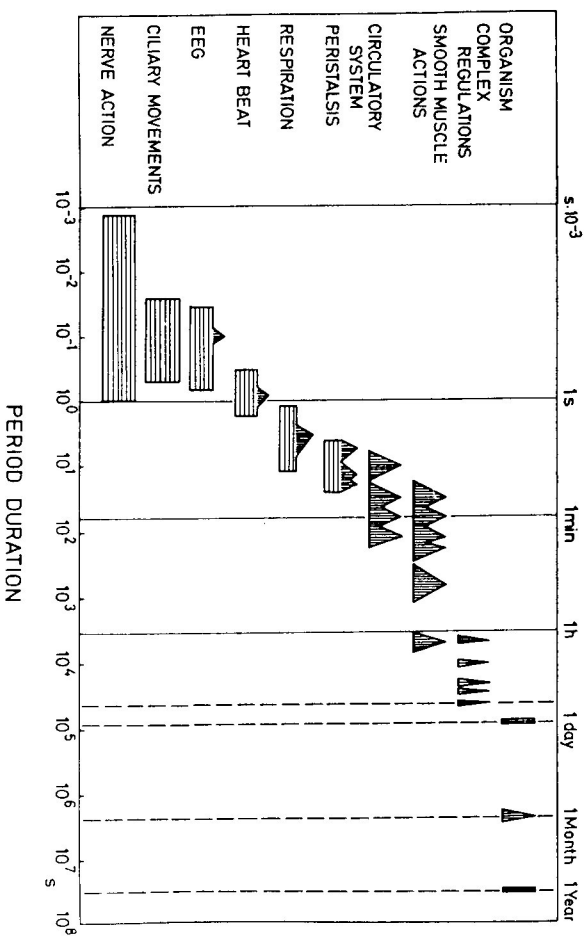


Fig.1 Whole spectrum of human rhythmical functions according to their period duration. Horizontal hatched areas indicate the range of frequency change under functional effort. Vertically hatched triangles indicate the statistical variability of frequencies in repose. (From Hildebrandt, 1967)

The rhythmical processes become more complex with increasing period lengths, for then they combine more and more functions into unified actions. Man's biological time structure is a hierarchically formed time organism, in which every rapid and more specialised rhythm is at the same time part of a slower and more embracing process.

Furthermore, by looking at the variability of the frequencies, or period durations respectively, of the various functions, as resulting from the width of the drawn fields, one can see that the variability decreases toward the long wavelengths of the spectrum. The greatest variability of frequency is exhibited by the nerve action rhythm, which portrays the momentary degree of excitation by means of frequency modulation. This mode of action is responsible for all the transmission and communication of information in the nervous system, so that one can speak of an "information system of rhythms".

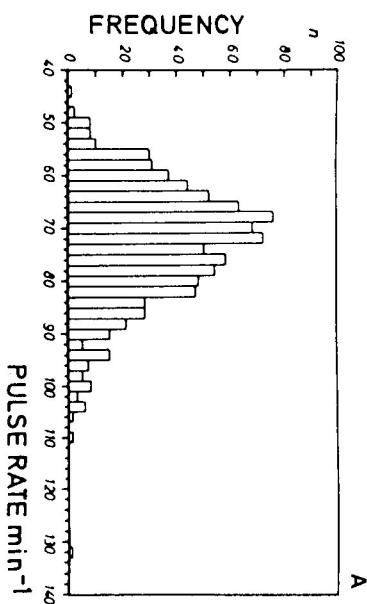
In the middle wavelength area, the frequency action is strongly determined by the required performance of the functions. The working and transport rhythms are those which increase their frequency continually with increasing effort, e.g. our walking pace, heart beat, and breathing frequency.

But at the same time, certain other factors show clearly that frequency performance is no longer solely dependent on effort. We are able to walk at any pace we choose, but we do not do so. We choose a certain set frequency, which we find to be particularly comfortable and normal. This is due to the fact that this chosen frequency is suited to our individual leg lengths, i.e. to its own particularly suited oscillation, but - as shown by several studies - also to a certain relationship to heart and respiratory rhythm.

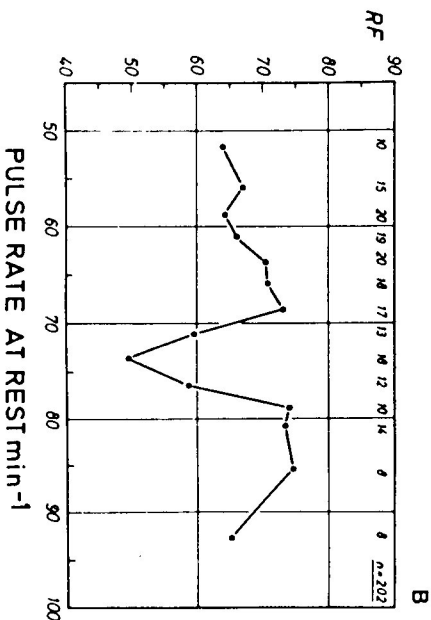
Here a new principle of frequency-setting asserts itself, one which sets frequency norms. It does this by connecting the rhythmical actions to a larger time structure, and thus at the same time, attains a better economy of the entire function.

Such responses can be demonstrated also in the autonomic rhythms of this field (Fig.2). If, for example, we were to give a larger group of people, with different levels of pulse rates, a dosed amount of work to do, and then measure the course of subsequent recovery by the area which the pulse rate covers until it returned to its resting value (control area), we would find that these area values would be definitely smaller at one particular point than in the rest of the scale. Here we are dealing with a frequency range of 72/minute. This conforms with the statistical norm as given by a comparison among the frequency distribution of pulse rates in repose (upper part of the figure). Therefore, the pulse rate that appears most frequently shows the optimum regulation, with the most rapid return to the state of repose.

Fig.2A: Frequency distribution of pulse rate at rest, measured on 903 adults.



B: Control areas of pulse rate (sum of pulse deviation from resting value, measured every 30sec) during the first 5 mins of recovery after an equally dosed work load (climbing up 3 steps 6 times in one minute, to a given timing) related to heart rate in repose. 202 experiments were made. (From Hildebrandt, 1960)



If one examines the respiratory frequency regulation by the same method of workload in relation to its resting values, one will come to an analogous result (Fig.3). The apex of the parabola-shaped functions, i.e. the optimum regulation with the smallest control area lies in the range of the normal resting respiratory frequency of about 18/minute, which is at the same time the most common frequency (upper part).

If we now compare these results, we will see that both of these functional norms are, in addition, marked by the fact that pulse and respiratory rhythm stand in a definite frequency relationship with each other, namely in the simple whole number relationship of 4:1. That this finding is not mere chance, but actually the expression of a functional order, becomes clear when we, for example, examine the control areas of the pulse frequency after effort, directly in relation to the quotient resulting from pulse rate and respiratory rate (Fig.4). We then see, independent of the absolute pulse rate, a clear minimum, i.e. optimum regulation, at the whole-number quotient of 4. However, one finds additional optima at other whole-numbered frequency relationships. The influence of the time order on the regulations must,

therefore, be based generally on the principle of whole-number frequency coordination.

By the way, Rudolf Steiner very often pointed out that the normal ratio of pulse to respiratory frequency is 4:1.

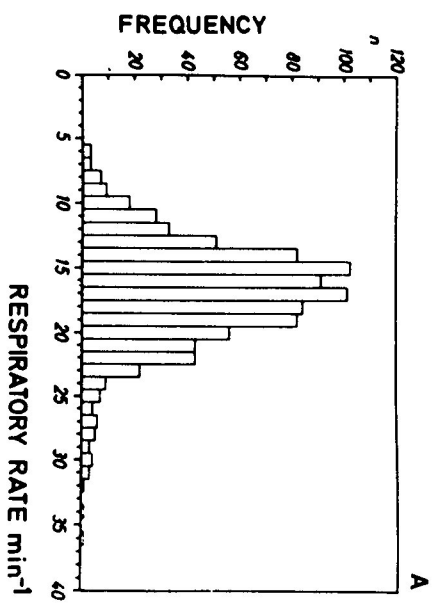


Fig. 3A: The frequency distribution of respiratory rate at rest, measured on 903 adults.

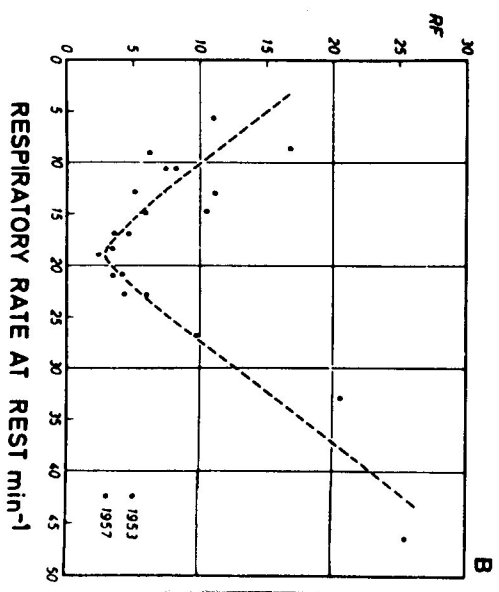


Fig. 3B: Control areas of respiratory rate during the first 5 mins after an equal work load related to the resting value. (From Hildebrandt 1960)

Fig. 5 shows a compilation of frequency distributions of period durations of circulatory and respiratory rhythms in the middle of range of wavelength, as determined by measurements on large groups of people. The frequency is, in each case, plotted to the middle. On the right-hand side, we find the circulatory rhythms: arterial basic oscillation, pulse rhythm, respiratory changes of circulation, blood pressure rhythms (so-called 10-sec rhythm), as well as the rhythm of the peripheral circulation, which normally takes a

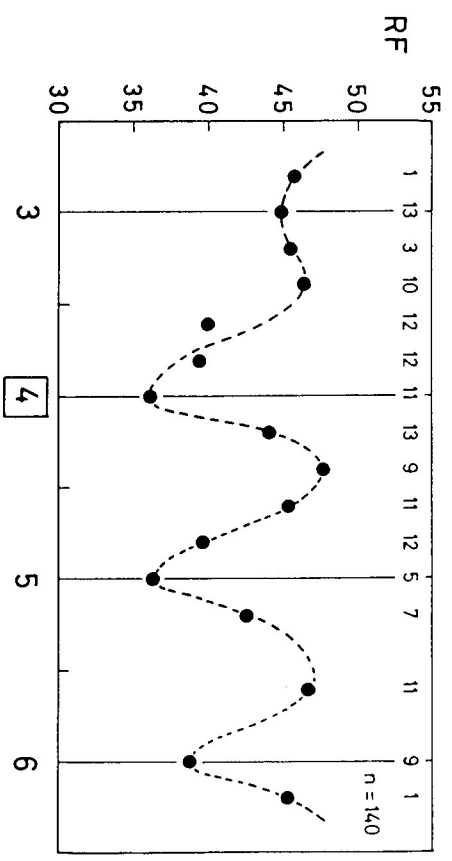


Fig. 4: Control areas of pulse rate (as in Fig. 2) during the first 5 minutes after an equal work load related to the resting value of the pulse-respiration-quotient. (From Hildebrandt 1966)

PULSE-RESPIRATION-QUOTIENT

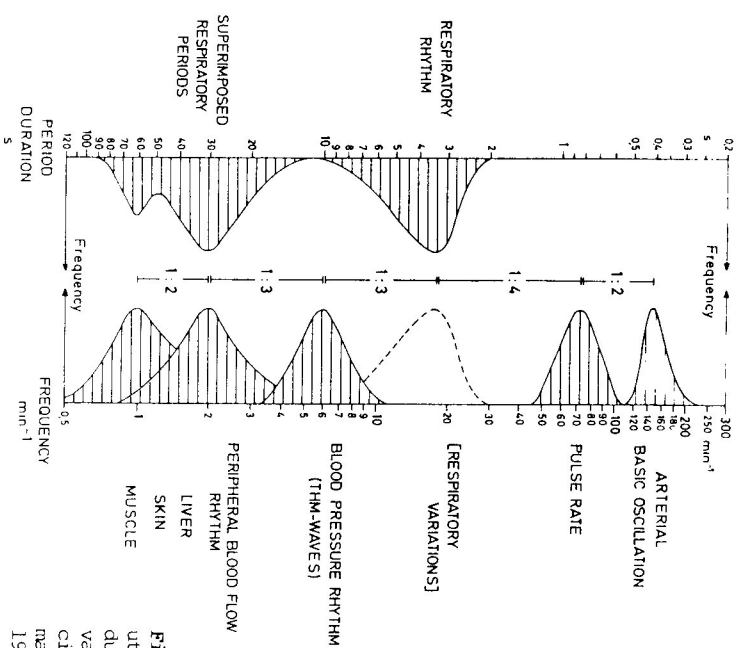


Fig. 5: Frequency distribution of the period duration, of frequency of various respiratory and circulatory rhythms in man. (From Hildebrandt, 1966)

RESPIRATION

CIRCULATION

cycle length of one minute in the muscles, as against 30 seconds in the skin and intestinal organs.

On the left-hand side, we see frequency distributions of the respiratory rate, as well as those of higher respiratory cycles, which superimpose the respiratory cycle, and which are usually synchronized with the oscillations in the peripheral circulation.

If we now compare the position of the peaks, we note that all predominant frequencies, that means all frequency norms, stand in a simple whole-number relationship to each other. Here we hit upon a whole system of harmonic time orders, a rhythmical functional order, whose state can definitely influence regulative performances. I would like to particularly point out that here we also find a direct connection between the physiology of man and the harmonic aspects, that have been fostered since the days of PYTHAGORAS through KEPLER, ALBERT VON THIMUS, and to HANS KAYSER.

Of course, this order in the middle area of the spectrum is only statistically realized and can easily be upset because some of the functions vary due to exertion. But, in periods of rest, and above all in sleep, this order is repeatedly reestablished.

If for example, we were to follow the daily course of the quotient of pulse and respiratory rate, with hourly measurements on healthy subjects under strict resting conditions, we would find that the measured rates vary greatly during the day (Fig.6). During night sleep, however, they tend to converge increasingly on a very narrow area. This area corresponds to the normal whole-number relationship of 4:1. This regulation (normalization) takes place without regard for the varying pulse frequency rates, which are noted in the right-hand column as a 24-hour average; a sign which shows, that the norm of the joint order matters more to the organism than the norm of every single function.

Without doubt, the harmonic temporal order of the rhythmic functions represents a basic principle of life organisation. This can be demonstrated by observations of smooth muscle actions. As shown in Fig. 7, even small isolated pieces of smooth muscle tissue (Taenia coli of Guinea pig) exhibit a spontaneous activity of rhythmic contractions with preferred period lengths of 1, 2, 3 etc. up to 8 minutes (GOLENHOFEN & V. LOH, 1970).

The striving for whole-number frequency relationships is only conceivable, if the rhythms, as such, influence one another. Such influences show themselves through the fact, that the rhythms tend to couple and, thus, to

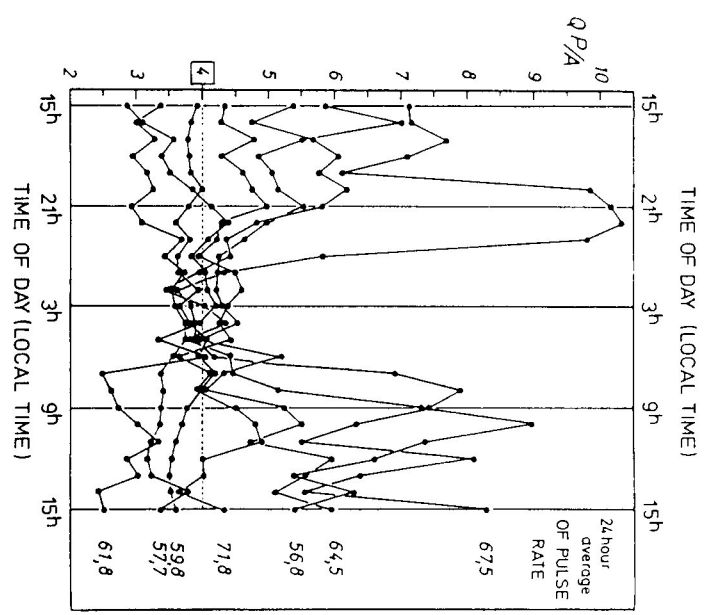


Fig.6:Nocturnal normalization of the pulse-respiration-quotient at different intervals of pulse rate (24 hour average). Hourly measurements of pulse and respiratory rate over at least 2 minutes. Healthy subjects in recumbency, taking identical meals at equal intervals. (From Hildebrandt 1961)

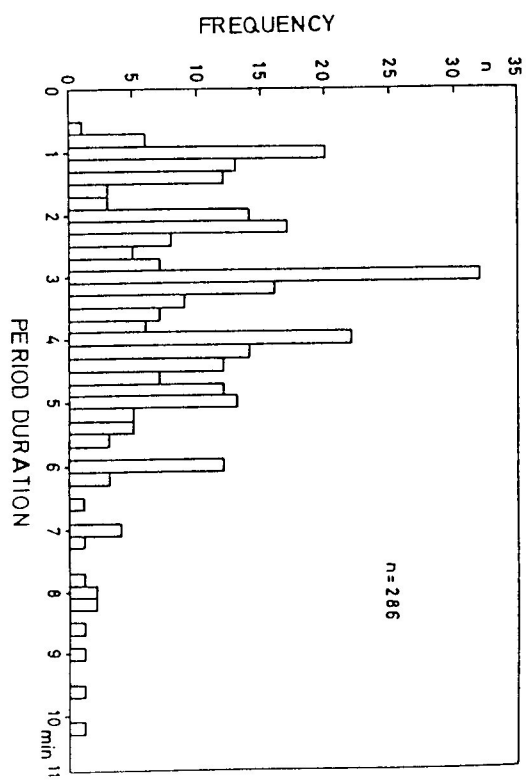


Fig.7: Histogram of period lengths of spontaneous activity of an isolated Taenia coli of a Guinea pig as registered during 18 hours under constant conditions. (From Golenhofen & v. Loh 1970)



adjust certain phase relationships to co-action. Such phase coordination can attain various degrees according to the strength of the link. In the middle wavelength of the spectrum, we find only the so-called relative coordination during the day, whereby the desired co-actions are preferred only statistically to any others.

Fig. 8 shows several frequency distributions of 100 inspiratory starting points in the heart cycle, measured at different times on a single subject. The heart cycle is measured by ECG from R-peak to R-peak and subdivided into 20 even groups covering five percent of the cycle length. While several smaller peaks before sleep indicate that the start of inspiration and heart beat do not run completely independently of each other, on increasing concentration of inspiratory starting points at a single peak develops during the period of sleep, indicating that inspiration begins preferably at one particular phase of the heart's rhythm.

When we approach the long-wave rhythms of the spectrum, the more confined becomes the structural order of the rhythms and the more pronounced the preference of certain frequency bands - those which stand in the whole-number relationship to another. Thus, in those areas covering several hours, we find almost only those rhythms whose cycle lengths stand in simple, whole-number relationships to one another and to the 24-hour rhythm (i.e. 4, 6, 8 and 12-hour cycles). As an example, according to the findings of MORATH (1973), even the spontaneous feeding cycle of newborns consists preferably of 4, 8 and 12-hour periods (Fig. 9).

Since the rhythms become increasingly more complex with increasing cycle length, and include an increasing number of single functions, the degree of phase coordination also becomes of constantly greater importance, since every single function must here be united in an orderly whole.

Fig. 10 shows mean daily courses of various functions. Here we see that all the curves keep roughly the same inversion times in their 24-hour rhythm. These turning hours of the daily rhythm are usually 3 and 15 hours, local time. This is where the phase and frequency coordination have reached a point of absolute synchronization. All partial functions are coordinated with the phases of the common functional aim: ergotropy i.e. activity and performance during the day, and trophotropy i.e. recovery and sleep during the night.

But there is more than simply an inner synchronization of all partial functions. The curves of the figure all originate from different groups of people. They will fit into the biological day only if there is an overall synchronization of the individual organism as it changes its phase position according to the local time.

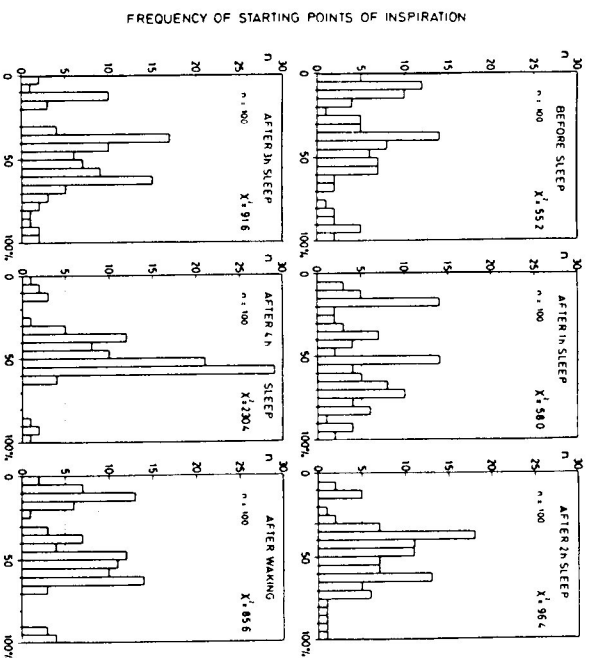


Fig. 8: Frequency distribution, each of 100 inspiratory starting points within the heart period, which is measured from R-peak to R-peak of ECG and divided into 20 equal classes of 5%, before and during night sleep, as well as after waking. Healthy subject. For evaluation of rate of phase coupling the  $\chi^2$ -values are given, which reach their limit of significance at 30.1 ( $p = 0.05$ ) (From Storch 1967)

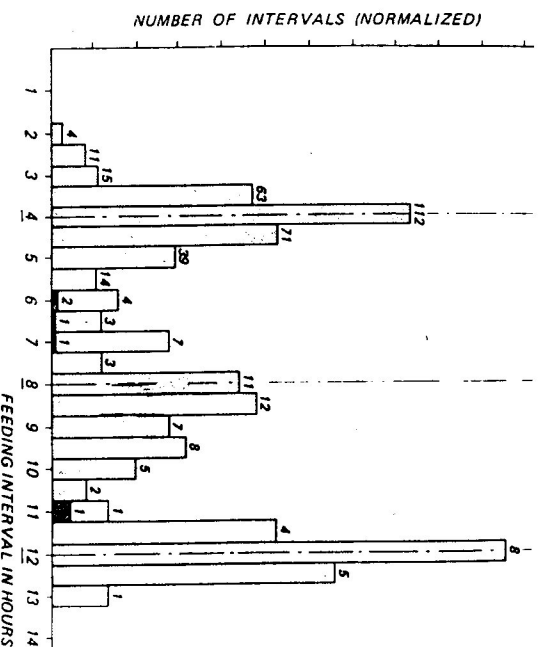


Fig. 9: Frequency distribution of intervals between spontaneously claimed feedings of infants from birth to 20 weeks of age. (From Morath 1973)

For a long time it was assumed that the 24-hour rhythm was controlled exclusively from the outside. However, the experiments as mainly performed by ASCHOFF & WEVER, could prove that for man, also, the day and night rhythm is anchored in the organism as a spontaneous, endogenous function, which is part of its structure, but is synchronized to local time by the influence of periodic Zeitgeber (synchronizers) in our environment.

If one were to isolate the organism from its surroundings and take away all time orientation (Fig.11), one would find that the endogenous rhythm would usually run on with only slight deviation of cycle length from the 24-hour period.

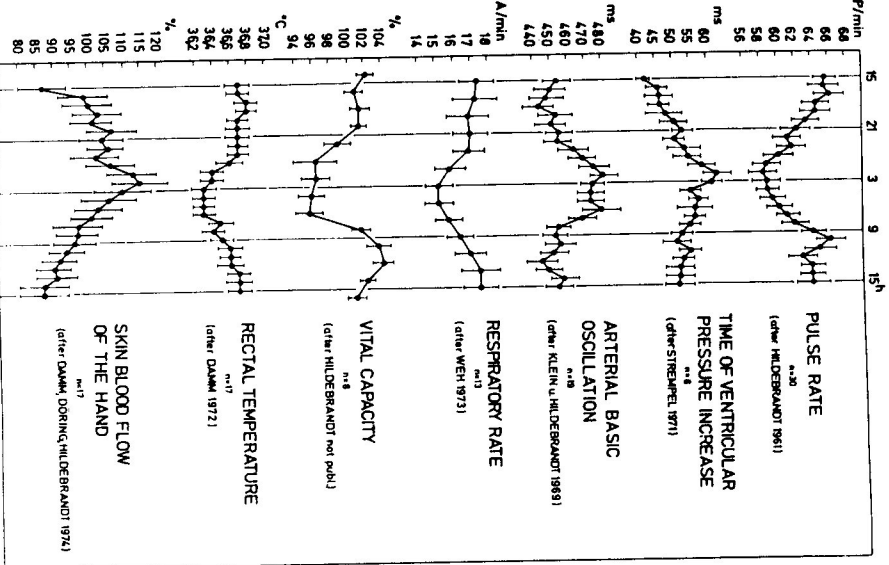


Fig.10: Examples of average daily courses of various functions in man under resting conditions and taking identical meals at regular intervals. (From Hildebrandt 1979)

One now speaks of circadian rhythms. As a result of experimental studies in animals and man, it has been found that a Zeitgeber is above all the light-dark cycle. Besides this, in humans an important role is played also by the socio-ecological factors, which impress themselves on our time consciousness. These factors may be more strongly influenced by the acoustical sphere. Finally, however, the rhythmical order of the organism is anchored in the super-individual time-order of the geophysical or cosmic environment.

This applies also to the biological annual rhythm. On the other hand, contrary to the many lunar rhythms in the animal realm, in the case of the human menstrual cycle, one cannot, with certainty, prove a synchronization with the moon cycle, in spite of the striking frequency coincidence or, as some authors have said, we can no longer prove it.

This closer examination of the rhythmical functioning order of man was necessary in order to show clearly that we are dealing here with an extremely differentiated time organism, in which disturbances and deviations must never be looked at in isolation.

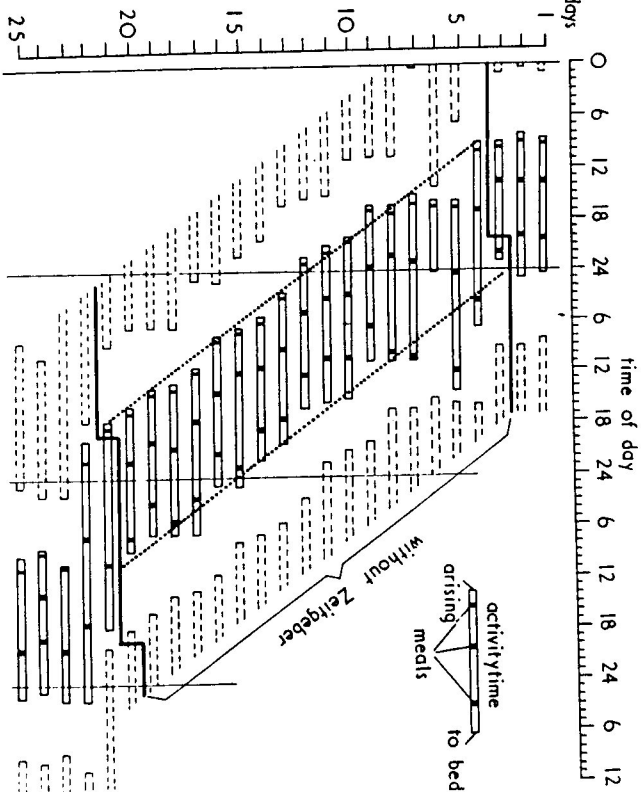


Fig.11: Circadian rhythm of the rest-activity cycle of a healthy subject, enclosed in isolation without time cues. (From Aschoff & Wever 1962)

Fig. 12 summarizes, once again, the findings in schematic form: The rhythmical functional order has a polar structure. In the short wave area, the rhythms are used predominantly by the specific functional performances and, therefore, show a frequency modulation of great range. The synchronized long waves of the 24-hour rhythm type are, on the contrary, fairly stable in frequency and phase position by their anchorage to the environmental order. Thus, they can build a base for an unspecified time order of the whole organism. This order is maintained by frequency- and phase coordination and continues with decreasing strength of coordination to fall into constantly finer parts, up to the point where the specific functional performances alone determine the time behaviour. The regulation takes place in equilibrium between both the polar parts. however, the centre of the system is rhythmically shifted between day and night.

Every deviation which a rhythmical function takes out of this orderly time structure of man, represents in principle a disturbance. such an event becomes the more serious the more long-wave functions become included. In the short-wave area, frequency deviations and suspended phase coordination are physiological: they are the basis of physiological performances. In the long-wave area, however, they finally endanger the correspondence of the whole organism with its environment, and so the foundation of the whole rhythmical functional order. It is this basis which is being attacked by man's emancipation from the natural time order.

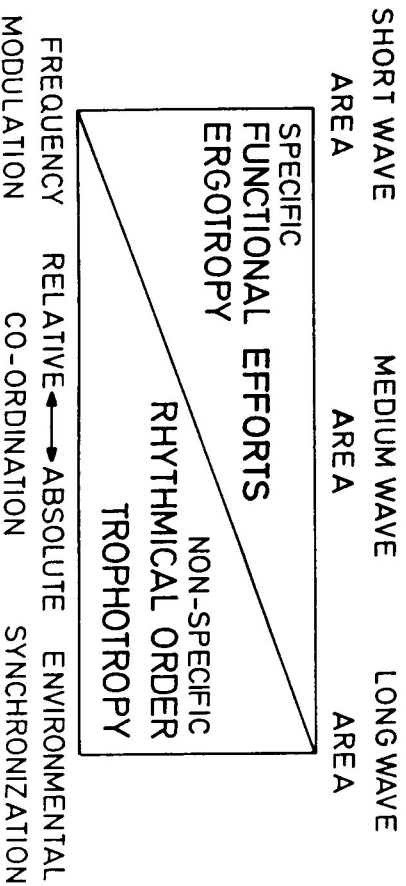


Fig.12: Schematic diagram of the polar structure of rhythmical functional order in man. (From Hildebrandt 1964)

While in its natural state the behaviour of the organism is mastered by the phases of the synchronized long-wave rhythms, civilized man no longer finds the rhythmical functional change compelling for himself - its phases tend to influence him only. But he remains free to act against this order and thus is able, up to a certain point, to establish his own time order. Today, we can clearly recognize the dangers and risks as well, which result from his freedom, especially in regard to the 24-hour rhythm, whereas in regard to the annual rhythm and the menstrual cycle we hardly have sufficient insight. These dangers lie mainly in the fact, that the exactness of the environmental synchronization of the 24-hour rhythm varies greatly for the different functions. Changes in the life schedule such as night and shift work, for instance, are able, after a certain latency, to replace the more performance-determined functions, and also to change waking and sleeping from their natural phase positions and fit them into changed activity programs. However, at least in so-called morning type subjects, the greatest part of the autonomic functions remains coupled to the geophysical environmental rhythm, so that disturbances of the inner synchronization become inevitable.

Many results could prove that also a complete exclusion of the Zeitgeber regimen by isolation experiments can lead to a desynchronization of various circadian functions, and this particularly in the elderly. Fig. 13 shows an example of such an experiment made by ASCHOFF (1966) in a bunker. Here we have a desynchronization of body temperature rhythm and the activity cycle. However, interestingly enough, there is still a coordination of the two functions, because the period lengths retain a harmonic ratio of 3:4.

Even after a quick transmeridian flight with a phase jump of local time, a transient inner desynchronization of the daily rhythm takes place, in spite of the complete phase shift of all environmental zeitgebers. This is because the different functional systems are synchronized with varying speed to the new phase position. Acclimatization is thus also a chronobiological problem.

I should like to clarify the effects of an inner phase dissociation by two examples.

Fig. 14 shows the normal daily run of the body's capacity for physical work, measured by the so-called physical working capacity at 170 pulses/minute on a bicycle ergometer. There is a fairly large amplitude, but astonishingly enough, the maximum working capacity is not reached during the day, but around 3 o'clock in the night, while the minimum occurs during the afternoon. One could, therefore, conclude that we sleep during the best part of the 24-hour period - at night. However, the maximum of the working capacity is but an expression of a maximum of circulatory and

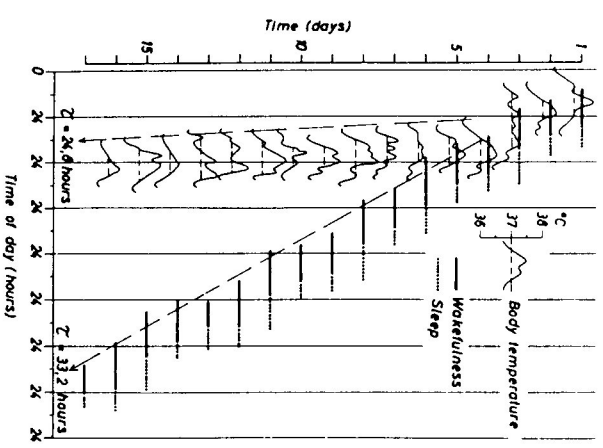


Fig.13: Circadian rhythms of body temperature and of activity of a healthy subject, enclosed in isolation without time cues. Values for successive days are drawn underneath each other. (From Aschoff 1966)

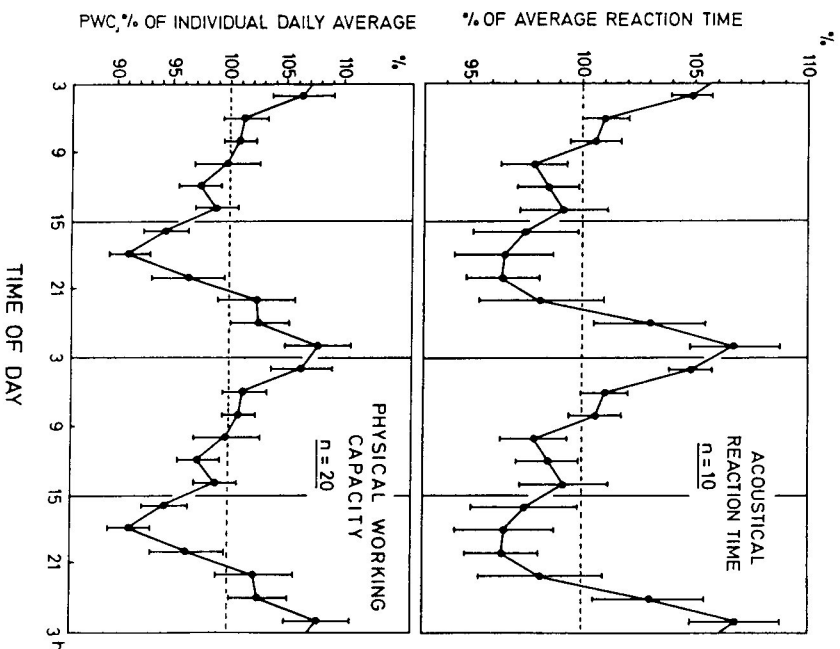


Fig.14: Upper part: average daily course of acoustical reaction time in 10 healthy subjects as measured at 2-hour intervals. Lower part: Average daily course of the physical working capacity at 170 pulse/minute in 20 healthy subjects. Both ordinates are scaled in percentage of the individual daily average. The brackets indicate the range of standard errors. (From Voigt et al., 1968)

metabolic economy, and at the same time gives the physiological prerequisite for the nightly recuperation and regeneration. As shown by the simultaneous examination of the rhythm of the psychic performance, as measured by reaction time, this phase is carefully guarded from exploitation through a minimum of psychic performance (maximum of reaction time). The breaking up of this phase adjustment must, therefore, lead to an unphysiological exploitation of the regenerative phase, and this is the reason why night work leads to a deficit of recuperation.

The second example concerns the fact that the organism itself, by normal synchronization, contributes to a stabilization of the normal phase relationships, in that it also rhythmically changes its sensitivity to the zeitgeber stimulus. Fig. 15 shows this by means of the autonomic reactions of healthy subjects to light stress, to which the eyes were permanently exposed for four hours, after eight hours of rest in the dark, at various times of day. We see, how the known reaction with activation of the adrenal cortex (a decrease of the eosinophils, an increase of cortisol excretion,

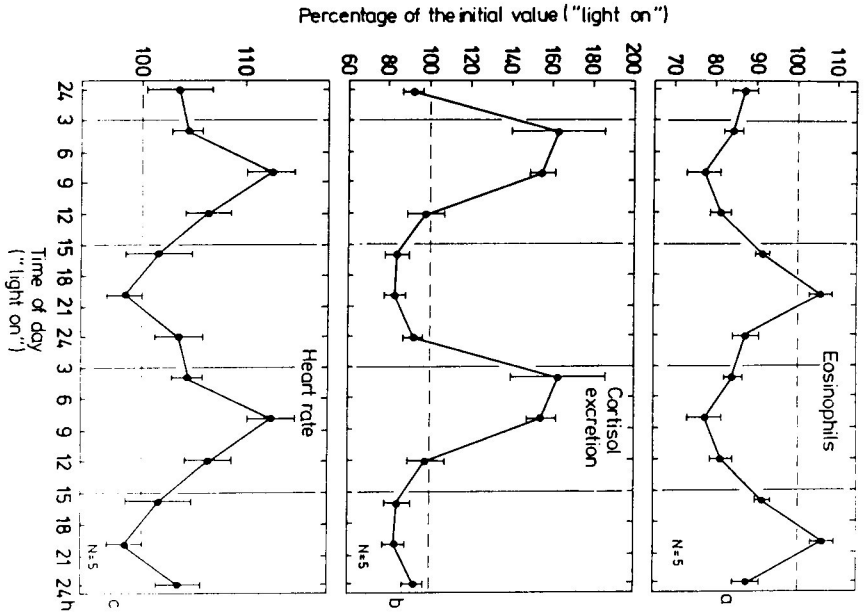


Fig.15: (a) Average daily course of change in the number of eosinophils after 2 hours exposure to light, following an 8-hour period of darkness, in 5 healthy subjects. (b) Average daily course of urinal cortisol excretion during the first 2 hours of exposure to light. (c) Average daily course of heart rate deviation during the first hour of exposure to light. The ordinates are scaled in percentage of the initial values at light-on. The brackets indicate the range of standard errors. To increase clarity, the courses are plotted twice, one after the other. (From Hildebrandt and Lowes 1972)

but also an increase in heart rate) is at a maximum in the morning, the time of natural light-on, whereas in the evening, there is a complete immunity to light. By means of such rhythmical changes of sensitivity, the organism presents itself to the morning light with maximum sensitivity, but shields against light at wrong times by means of decreased sensitivity.

The daily cycle of such an extensive change of responsiveness is naturally bound to the right phase synchronization of all partial functions. We can, therefore, expect that a disturbance of this inner synchronization leads also to a weakening of falling off of the organism's physiological contribution to stabilizing its phase relationship to the environmental order.

Under all these prerequisites, it is not surprising that pathological results were feared, where disturbances of this orderly relationship to the environment are taking place systematically, for example night and shift work. Their proof, however, was difficult, because those concerned are under a considerable selection, and there are obviously constitutional differences in the toleration of such disturbances, mainly related to the circadian phase position: morningness - eveningness. Fig. 16 shows, as an example, the correlation between the subjectively rated circadian phase type and the individual tolerance to night work in a group of nurses.

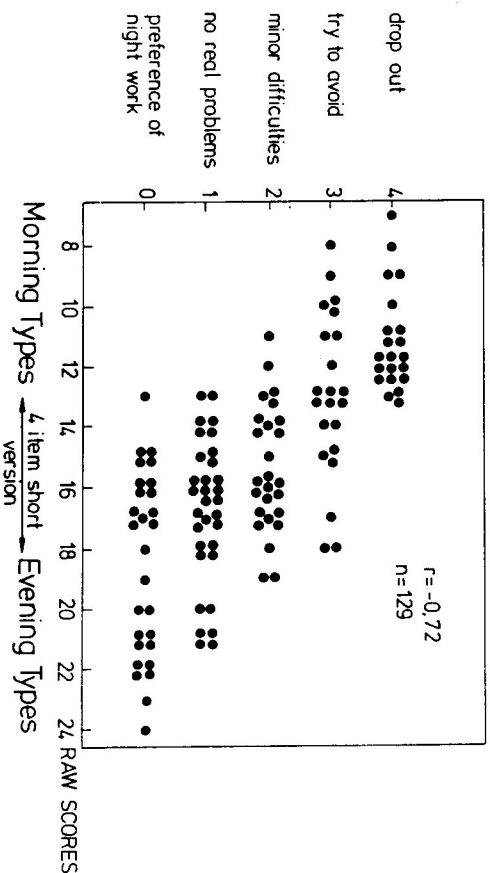


Fig.16: Correlation between self reported night-shift tolerance and subjectively rated circadian phase position. (Data from Pöllmann in Hildebrandt 1986)

We have known for a long time that there is an increased number of disturbances of the digestive tract in night workers. Other results, especially those regarding heart and circulatory diseases, remained a controversial point for a long time, because the latency of the disturbing effect was not estimated correctly. Today, we know the results of longer periods of night and shift work appear in the form of greatly increased sickness figures only after a latency of many years.

It may be said, that all results up to now in the field of medical rhythm research lead to the conclusion that the experiment of man's emancipation from the natural time order must fail. Man is bound to the anchorage of his rhythmical functional order in a rhythmic environment applying specifically to the earth, unless he wishes to destroy the basis of his biological time organism (etheric body). Thus, even as an astronaut he will not be able to do without an earthly Zeitgeber pattern as well as earthly food and oxygen.

The consequent consideration of the aspect of time in biology and medicine will lead to adoption of a kind of chronohygiene of behaviors in the field of preventative action, which will lead us to the point, where we consider the biological time order with real understanding. This, however, presupposes considerable change of emphasis in the scientific world.

Already in 1906, Redolf STEINER pointed out that man's development of freedom is necessarily connected with his emancipation from the natural time order of the environment. However, he emphasized, this process will come to an end, where the destruction of the biological time structure will endanger the basis of life. Then, man must develop a new temporal order of his own free will.

For over one hundred years, biology and medicine have remained under the ruling influence of the dogma of homeostasis, which since the time of Claude BERNARD, has considered the vital processes as serving to maintain a constant inner milieu which is characterized as a material, physico-chemical equilibrium, forming the basic prerequisite for the continuance of life. This aspect was broadened somewhat recently, for example, through the theory of *Fließgleichgewicht* (Flowing equilibrium), which perceives the organism as an open system, but the basic principle of regulation has been retained, aiming at constancy in relation to vital processes. In addition, the successful use of cybernetics in biology and medicine has contributed to the further consolidation of this aspect.

The evidence established by biological rhythm research in chronobiology, that all vital processes are subject to regular spontaneous fluctuations, can, in the first instance, still be explained by the fact that technical

regulative systems also permit periodic variations of the factors they regulate, because the corrective process, which any change produces, becomes effective only after a certain time-lag. It was only the discovery of the general hierarchically-ordered time structure of the organism, maintained by coordination, which made it clear that this structure has its own criterion of order, and that this structure must be more than a mere by-product of imperfect regulation aiming at stability. Homeostasis of the vital processes, therefore, can be only one component aspect of the organization of the vital processes; it must be supplemented by homeodynamics, which considers and examines the orderly reactions of all rhythmical processes as an expression of a comprehensive structure of life.

The sum up: the subject of time will be of significance in the future development of biology and medicine not only because in the past it was neglected in favour of spatial and material aspects, but also because the problem of temporal arrangement and environmental dependence has become a specific problem in the face of man's progressive emancipation. This emancipation has pathogenic as well as preventive and therapeutic significances.

The time structure of the organism (the etheric Zeitleib) is marked by a rhythmical functional order, which is of polar structure. In the short-wave area, the rhythms are used mainly for specific functional efforts and, therefore, show frequency modulations of great range. As opposed to this, the long-wave rhythms, e.g. the 24-hour cycle, are synchronized with the environmental time order, and thus are stable in frequency and phase position. Therefore, they form the basis of the whole rhythmical order, which is maintained by frequency- and phase coordination. Regulation takes place in equilibrium between the two components.

While in the short-wave area one can see the disturbances and deviations of rhythmical functions as physiological, in the long-wave area they increasingly endanger the environmental order of the organism and thus the basis of its time structure. Today, we are in a position to prove the existence of such disturbances under various conditions. The results which medical research has obtained so far, prove that the human organism is dependent on its anchorage in the earth's specific environmental time order. It is necessary, therefore, to combat man's increasing emancipation from time with a chronohygiene of behaviour, which must be based on a true understanding of the biological time order. The development of adequate scientific fundamentals will require that homeostatic viewpoints be supplemented by homeodynamics.

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#### CHANGES IN THE CONCEPT OF ENERGY

Georg Unger

[From "Mathematical-Physical Correspondence", No.153, Summer 1989.

Translation by Ron Jarman and Hans Geburt.]

In classical mechanics the concept of work gradually became clearer. It then became known that the work involved in acceleration is proportional to the square of the speed of the accelerating body. That led to the concept of kinetic energy (in which naturally the mass of the body has to be taken into account). Long before the concept of the change from one form of energy to another there arose the final principles of mechanics. If one gathers together their natural philosophical content without metaphysical speculation, they indicate that in the Lagrange function of kinetic potential or in the Hamilton-Jacobi energy function the whole structure of a mechanical system is contained. That is to say when one applies the final principles (and the knowledge of forces which eventually are not conservative) the course of the movement, in other words the development in time, of the mechanical system can be described exactly.

Later, R.J.Mayer discovered the equivalence of heat and work. He did not yet speak of conversion but of correspondence. Rumford and Joule established this numerical equivalent independently of him. Gradually the concept of energy acquired strongly "substantial" character as a unit of conservation. Light, warmth etc. are no longer forces of nature but forms of energy. The first principle in the theory of heat appears generalised as the principle of energy for the whole of physics. The idea of energy developed in the 19th Century idealised the conservation of mass and energy as the basis of a universal materialism of force and substance. The two together form the real basis for the actual world.

The discovery of radioactivity and Planck's Hypothesis of quanta effects opened the door to fundamental modification of the ideas about matter and energy.

The apparently uncreative production of heat from radium and the discovery of the breakdown of uranium and thorium contradicted the idea of the unchangeable character of matter and of (naive) energy conservation. The "energy of cohesion" developed out of chemistry and the physics of crystallography through latent heat concepts had to be expanded into the idea of nuclear forces and their energies. The demand by Planck for energy quanta arising from the theory of ray emanation led to a destruction of the energy concept, although it was not easily perceived. For energy appeared to be atomistic in any case, but the new energy-atoms do not have constant sizes once and for all, but are proportional to their frequency of occurrence. As a result of Einstein's hypothesis of light quanta there arose the problem of the duality of waves and particles, which was fully grasped later on.

In a development which we cannot go into in detail here, the mathematical framework of quantum theory was then developed, and this provided the guideline for the further building up of ideas.

The energy concept seems to be untouched as far as profile formulations are concerned. The conservation of matter gives way to mass-energy conservation. At least the conservation of particle count - with the negative anti-particle count - does not enter into popular consideration. Thereby, however, we touch upon an idea which remarkably enough has given no occasion for discussion. It is the proposition of the conservation of impulse.

We can ask the somewhat rhetorical question, why have we turned aside from a comprehensive impulse proposition but not at the same time from a substantial conservation unit? The answer lies in the fact that it is too evident how impulses "arise" and "pass away", for instance in the discharge of any kind of ejection machine (from bows and arrows up to cannons). There are also always present opposite impulses so that the total algebraic sum is zero. In a similar way we could deal with the occurrence of oppositely orientated electrical charges well known in an electrical field. But long before the experimental proof of electrons the idea of their particle character had already been settled. Naturally, you may say, on account of the Faraday "transport number". And, if I may continue this, on account of the absolute faith which people had in chemical atoms in the previous century.

The older theory of electricity was easily able to build up a useful postulate of two mutually cancelling streams of positive and negative

charges; nevertheless the atomic ideas were stronger. The half-material properties of cathode rays influenced the idea of electrons convincingly. Analogous phenomena which would provide the impulse to a similar materiality are missing (such as magnetic particles).

On account of the square of the speed a negative kinetic energy cannot exist; and so from the beginning there is no case for a half material energy concept. (A negative relative speed does produce a positive force - as for example an insect impacting against a car windshield.)

An example: In the isothermal compression of an ideal gas the work of compression, just as much as the warmth produced, is counted negatively, but otherwise potential or thermal energy is thought of like other positive natural measurements. In the atomistic picture the correspondence is between the potential work of compression and the hidden work of energy of the free molecules of the gas and between the release of heat and the hidden kinetic energy of the warmed up body (or also freed energy in the case of another gas).

As a curiosity we may remember that no less than Heinrich Hertz took old potential energies as movements of hidden masses in his mechanics; and he wanted to stick to a single principle so that apart from space and time only mass comes into question for mechanics, thus neither forces nor other forms of energy such as kinetic energy.

This digression as to why there is no quasi-material comprehension of impulse, despite its conservation, and why there is no energy that is actually negative, will prepare the next step which consists of throwing light upon the information-character of energy. Already, long before the problems of wave-corpuscle duality, energy had slipped unnoticed in the structure of its various forms into a function of a mechanical system which was solely ordered but not active. All this despite the quasi-material idea accompanying the concept. Using a drastic example, let us ask the question "why does a lift move upwards?" Answer: because there is a dynamic balance between tension in the cable, and weight. "And the motor?" Here there is a balance between torque and turning moment, whereby equilibrium is stable.

"And is not the consumption of energy the cause?" Answer: it depends upon another line of argument covering (1) contact resistance (2) lever effect (3) electrical loss. We could ask all sorts of questions, for example: "Why upwards?" And continually have to give answers which indicate the cause to be neither in the forces or the energy but in their ordering in the construction.

Thus neither is the tension in the cable nor the consumption of current the "cause" of the movement. But the structure is. It was indicated in the

example in the line of argument.

This consideration is still comparable with the idea of certain "streams of energy" which become familiar in technology by means of diagrams: in the motor out of the armature from electrical to magnetic form, in the position of the anchor into mechanical form, then through the cable and finally the hoist with the corresponding losses being taken into account.

When considering ray effects, however, this way of observing becomes quite unrealistic. It only has meaning in statistical profiles. If we want to keep to the idea of physical theories describing "reality", then the quantifying of energy, for example through photons, must be thought of as fundamental, in the way this was consequently followed through by Feinmann as Q.E.D.

Already, however, a quick observation of Feinmann's way of viewing the matter shows that this has nothing whatever to do with real events but to do with the summation of virtual proton paths, which are combined according to certain phase rules. The actual event is then revealed to be an accidental one whose probability is governed by the aforementioned addition.

Many other paradoxes of "Quantum Reality" arise here. (See Nick Herbert, Rider, London, 1985). This makes unavoidable the position: Energy has lost its quasi-material character in favour of an ordering principle that one would prefer to call Information.

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C O R R E S P O N D E N C E

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BIO-DYNAMIC CONSTELLATION DIVISIONS

Dear Editor,  
Bio-dynamic calendars employ constellation divisions as given in the Sternkalender of the Anthroposophists, to mark the moon's journey through the four zodiacal elements. BD sources merely say of these divisions that they are 'astronomical'. I suggest that this matter is worthy of further discussion, not least because astronomers have in fact never used such constellation boundaries.



In 1930 the International Astronomical Union demarcated the constellation-boundaries of the ecliptic constellations, all 13 of them. The IAU decided - possibly intending it as one in the eye for the astrologers - that the traditionally overlapping areas of Ophiucus and Scorpio\* be taken as Ophiucus, and accordingly gave to this constellation 19° of the ecliptic, leaving Scorpio with a mere 7°. Those who derived the B.D. calendar decided to ignore the Ophiucus constellation and to take the whole length of this sign as being Scorpio. Far from the B.D. sowing calendars using the astronomical divisions as given by the IAU, they are using a unique, home-baked system which is neither fish nor fowl.

Other boundaries too have been altered. The Thun calendar, following the 'Sternkalender', has made the short constellation Libra shorter, and the longest constellation Virgo yet longer. Let's look at this. The IUA's zodiac constellation divisions range from Cancer as the shortest with 20° 03' to 43° 58' for Virgo, and give the following lengths of four adjacent zodiac constellations:

IAU Longitudes:	Sagittarius	Ophiucus	Scorpio	Libra
	33° 25'	18° 57'	6° 18'	23° 10'

Combining Ophiucus and Scorpio gives a value comparable to that used as 'Scorpio' in the Thun calendar. We can show the difference between the two schemes as follows:

Zodiac Constellation Lengths:

	Sagittarius	Scorpio	Libra
IAU	33° 25'	25° 15'	23° 10'
Thun	29.5°	31.2°	18°
Discrepancy	-4°	+6°	-5°

The bottom line shows the difference between BD constellation lengths and those used by astronomers (the constellation divisions used in Thun's calendar were here derived using a computer program for lunar longitude and the calendar's ingress times, taking an average as they were to the nearest hour). The BD calendars add on just over two degrees to Virgo's length, making it 46° 20'. Views on how this situation came about are hard to come by: some early calculation error, perhaps?

\* Ophiucus started life as Asclepius, who as a physician of Cos became too successful and started raising the dead, whereupon Pluto complained and Zeus struck him down then raised him up into a constellation, where his right foot, where the Milky Way crosses the Zodiac, steps onto Scorpio. Traditionally, this area was regarded as belonging to Scorpio.

The BD sowing calendar was developed when the ancient Sideral Zodiac (as used by the Three Magi) had not yet been well deciphered from the cuneiform tablets now in the British Museum. Those who nowadays advocate the BD calendars always ignore the equal 30° division Sideral Zodiac that has since become widely recognised, defined with respect to the Antares-Aldebaran axis. Experimental evidence has been published (by myself) with lettuce and radish indicating that the 4-element pattern in crop yield showed up better using the regular 30° divisions of the star-zodiac than with the irregular divisions of the BD constellations (1). 'Star and Furrow' has stopped taking experimental results which I sent them, perhaps because they did not appreciate critical comments I made about their calendar divisions (2), which has not encouraged me to perform any further experiments of Moon rhythm/crop yield.

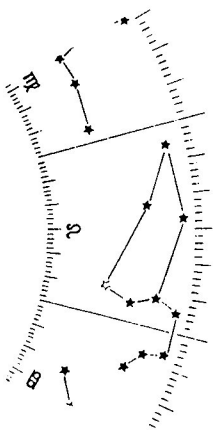
The elements are askew in the BD constellations, giving the 'Earth-constellations' more than half as much again in zodiac space than do 'Air-constellations' (which could be irritating the sylphs!). In consequence the Thun calendar shows the 'trigons' (sky-triangles of the elements) as of irregular shape, violating principles of Platonic philosophy. We may believe in the linkage of the 4 elements as earth-water-air-fire to the 4 crop types root-leaf-flower-seed, indeed this links up somewhat to the physical-etheric-astral-spirit quaternary, but we should rightly cultivate this insight envisioned by Maria Thun.

Claudius Ptolemy laid the corn-goddess Virgo out horizontally, occupying well over 40° of the ecliptic, after which the symmetry of the 12 constellations had no hope. But, this profane act - possibly from sailors' tales of how the constellations were meant to be, who had forgotten the Chaldean image of a vertical Virgo, modestly occupying a 30° sector as she was supposed to do - features only in his Almagest, while a 30° division star-zodiac is used in his Tetrabiblos. The 4 elements only arrived in the star-zodiac after Ptolemy's day, associated with the Syrian Vettius Valens later in the 2nd century, in which case it is his zodiac framework which, I have argued, farmers ought to be using (3).

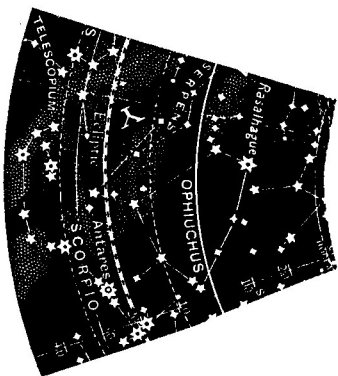
A fine new American initiative appeared in 1989 when the Kimberton Hills Agricultural Calendar of Pennsylvania announced that its constellation divisions were to be based on those of Paul Platt. Mr. Platt evolved his divisions from personal experience, and has published some large volumes about it (4). His scheme merits serious consideration in my view, because it has the virtue of assigning a roughly equal division of cosmic space to each of the four elements - a matter in which the BD scheme fails so lamentably. The Kimberton Hills Calendar switched back to the old system after a year or two, as a result of criticism.

Some take the view that the integrity of traditional constellation-images has a paramount importance in this context, though I suggest that this is not self-evident. For example, in the equal-interval Sidereal Zodiac, Leo loses his head (see Figure), while from the boundaries discerned by Mr. Platt it is retained. Let us hope that calm and constructive discussion can improve our understanding of these matters, and overcome major blunders of the past.

Nick Kollerstrom



Sidereal Leo  
(from R. Powell's 'Sidereal Zodiac Chart')



The Constellation of Ophiuchus

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- 1) N. Kollerstrom, Science Forum No. 2, 1980, pp18-21.
- 2) See 'Zodiac Rhythms in Plant Growth', Star and Furrow, Winter 1984.
- 3) Best and Kollerstrom, 'Planting by the Moon', ACS San Diego, CA, 1982.
- 4) Paul Platt, 'The Qualities of Time' Vols I, II & III, 1988, New York; Kimberton Hills Calendar (Pennsylvania) 1989, p11.

R E V I E W S & C O M M E N T

THE MYSTERY OF PHYSICAL LIFE - E.L. GRANT WATSON

[Paperback, £7.99, Floris Books. Previously published 1964 in New York]

"A fool sees not the same tree as the wise man sees" (William Blake)

Familiar names surround the main text of this extremely interesting book, with a foreword by Dr. Ralph Twentyman, a preface by Owen Barfield and an Appendix by George Adams. For the less well sighted the print is pleasantly large too: the author, Grant Watson, lived between 1885 and 1970.

The survival of the fittest, Darwin's no need for God theory, is not Watson's idea of sensible science, and "the chapters of this present book are set...in the early centuries before Christ" aided by Teilhard de Chardin's *The Phenomenon of Man*. Instinct takes on new meaning when certain symbiotic relationships are observed (the sea-slug's nematocysts, and the fig's gall-wasps); instinct, "if endowed with self-regarding intelligence...would say: I and my environment are one".

He uses the differentiation rock (physical), plant (+life), animal (+desire) and man (+ego) -familiar to most of us- and Jung, Cook and Fibonacci to illustrate, very eloquently, the need for scientists to sit back and observe. With the help of many friends, including George Adams, (he quotes liberally), Watson argues that the mysterious, or the spirit, plays as important a part as the predictable, developing the ideas of the archetype, thoughts in negative space, and the fundamentalism of form. Steiner "affirms that we can train our imaginative faculties to become instruments of cognition no less conscious and exact than mathematical reasoning".

Examining some very strange adaptation phenomena, including jelly-fish and their inhabitants, hermit (and other) crabs and sea-anemones, coral crabs and the fantastic life-cycles of Saccolina and butterflies, Watson suggests "that this process of metamorphosis represents the working of a concrete idea upon a plastic material". In a chapter interestingly mis-titled *The Creative Word* (should be *World*) examining the works of numerous poets (Blake, Spenser, Milton, Goethe, Coleridge, Rilke and Parnaudes of Hermes) he shows how the inner relationship to Nature is more accessible to poets than scientists; he likens the changing states of the mayfly to the need for us to develop... "this second change might seem unnecessary, but so it is. And so it may be that a second change is demanded in the psychic development of man".

Leaving the undisturbed natural world Watson uses Melville (Moby Dick) and Karen Blixen (Out of Africa) and others to illustrate the way men can influence and be influenced by the animal world, living almost as part of their kingdom. He goes on to examine many differing views on clairvoyance, speculating about the states of consciousness of animals, developing the idea that each has some part of the universal consciousness. Sense awareness is also varied, be it colour or dimension; and the biologists need to deal with uncertainties (the Heisenberg uncertainty principle) becomes significant when looking at creation and embryology.

The apparent intelligence of sperm, starting the process of expansion by division, leads Watson to analyse DNA. Adding the sea-slug and other previously examined phenomena he suggests that a clairvoyant principle is more likely to explain life than analysis of microscopic substance. He again looks at the poet and the scientist; the importance of external and internal forces can be understood by the reciprocal relationship "between the mystery of life and an emergent consciousness, activated...from the centre of growth...[and] cosmic influence" or by scientific analysis of DNA. Artificial grafting of egg tissue can also show the effect of an external "organising" principle.

Watson closes with death, illustrating the immortality of cells with more fascinating anecdotes (especially Paramedium). What causes death in old age? Using Nietzsche, Goethe and Shakespeare alongside scientists of his day he points again to the apparent divide between the two communities, culminating in Keats: "Death is Life's high meed" and Jung: "[Lifting] the veil of Maya...is an ideal that can only be completely realised in death".

**The Mystery of Physical Life** is accessible to anyone with an interest in the meaning of life, and contains much, much more than Grant Watson's ideas alone.

Bruce Jackson

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**SES NEWSLETTER**

The Newsletter of the American-based "Society for the Evolution of Science" is published twice-yearly, with similar aims to Science Forum. The main contents of the last 4 issues are summarized below.

Volume 9, No.1 (January 1993)

**Old and New Perspectives on Desargues' Theorem** by Stephen Eberhart.  
(Definitely for mathematicians!).

**A Book Review** - "Mind & Matter: Imaginative Participation in Science.

Volume 8, No.2 (Summer 1992)

**Exploring the Sub-Sensible World** by Robert C. Delhaf. The author examines causality in the different levels of Nature. The TPUS is the causal principle in organic nature. In the inorganic world, natural laws revealed through primary phenomena (Urphenomene) operate. In the sub-natural, sub-sensible domain (magnetism, electricity, nuclear effects), the observable facts are created by our experiments, and from these, we devise field theories and suchlike, which play the role of "causal principle".

**The Basic Phenomenon of Cosmology** by Konrad Rudnicki, is a study of different approaches to the Cosmos: modern academic cosmology, with its models of various universes, helps us to understand our REAL Universe. But it assumes that all phenomena can be explained in physical terms. A Goethean/Anthroposophical approach, which includes for example the etheric forces, can lead to higher thinking possibilities in grasping the Universe.

Volume 8, No.1 (January 1992)

**New Consciousness, New Thinking, and the New Physics** by Arthur Zajonc. Professor Zajonc sees the strange world revealed by Quantum mechanics as a symptom of the way our thinking is evolving. Such concepts as "non-locality" and "entanglement" can only emerge in quantum physics because there is an inner shift in our thinking such that we feel these qualities in the realm of life.

**The Rhythm in the Embryonic Period of Development in Birds** by Friedrich Klipp. This article first appeared in the "Star Calendar" (in German) in 1951, and is an attempt to show the biological reality of the rhythm of the week.

Volume 7, No.2 (July 1991)

**Is the Copper Chloride Crystallisation Method a Test for Detecting Formative forces in Living Materials?** by Rolf E. Hummel. Crystallisation patterns have been used empirically for years as an indicator of formative forces ("life forces") in plant extracts, blood etc. The more organised pattern produced when such extracts are added to copper chloride solution, has been reproduced by Mr. Hummel using a synthetic polymer of known molecular weight; apparently this parameter correlates well with the degree of organisation of the resulting pattern. This leads the author to conclude that the notion of the copper chloride technique providing a decisive test for formative forces, is not supported. However, care is needed in interpreting his results, as pointed out in a letter published in the latest issue (Vol. 9, No.1). The conclusion may even be the reverse of what Mr. Hummel assumes.

Also in this issue....

Beyond the limited goddess of objectivity or why is mathematics so well adapted to the objects of reality? by Detlef Hardorp.

The Physical Body and its Relations to Higher Ones by Georg Maier.

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Howard Smith

R E V I E W

**Dr. Bockemuhl's New Approach to Heredity**

The pioneering work on heredity being carried out at Dornach under the direction of Jochen Bockemuhl continues to progress and diversify. In an article in 'Elemente Der Naturwissenschaft' No. 45, entitled 'Steps to a Living Concept of Heredity, Craig Holdrege further develops the concept of the plant type and its role in heredity, paying particular attention to the ways in which it may come to manifestation under different environmental conditions, in different relationships to the course of the year, and subject to the constraints imposed by each individual seed-substance. The phenomenon of heredity is approached as a whole, embracing qualitative, environmental and time-related aspects, while the role of thinking is seen as a vital, objective element in the whole process.

The article also addresses the important question of approaching the theory and practice of modern genetics from this wider standpoint - to show not only their reductionist nature but also how other forces, not yet reflected upon, are at work in this field. The section headings, reproduced below, give an indication of the scope and content of the article:

1. Milestones in the study of Heredity

1.1 The work & experimental results of Gregor Mendel

1.2 Theoretical interpretation of Heredity phenomena by Gregor Mendel

1.3 The Chromosome theory of Heredity

1.4 The material basis of Heredity

2. A phenomenological consideration of the thought-processes in Genetics

2.1 A narrowing of the field of vision

2.2 The conceptual side of Characteristics is misunderstood

2.3 The objective in thinking

2.4 The plan becomes objective thought

2.5 Matter replaces thought

2.6 Genetic Information

2.7 Concepts and Non-concepts

3. Heredity in the Plant in relation to Environment and Thought

3.1 Three examples of Senecio vulgaris

3.2 The concept of the Type

3.3 Type-forms in different Light-conditions

3.4 The Type during the course of the year

3.5 Heredity: Plasticity and Limitation

3.6 Generation-sequence of the Type

3.7 Heredity - in its entirety

4. The Future Outlook

The work in progress at Dornach also includes, more generally, an epistemological investigation of results and interpretations of molecular biology, with the object of demonstrating not only its limitations but also how the data of this science themselves hint at non-physical or non-chemical qualities of the living.

Johannes Wirtz is currently in the process of observing animal development in order to re-define concepts of heredity and evolution in the animal kingdom. Preliminary results indicate that in studying ontogeny one must go beyond the consideration of the development of forms as such and include environment as an essential aspect. The dualistic paradigm of random mutation and selection by the surroundings, in contemporary evolutionary theory, can perhaps be replaced by a wider, holistic vision in which the two factors are seen as inter-dependent and aspects of the same spiritual whole?

In an article in 'Elementa Der Naturwissenschaft' N. 53, "Schritte zu einem neuen Ansatz in der Entwicklungsbiologie", Dr. Wirtz applies his approach to the study of the development of the brown grass frog, *Rana temporaria*. The investigation shows the development proceeding in three stages: embryonic development best described in terms of the physical characteristics - warmth, air, moisture and weight; the larval period in which etheric forces and interrelationships predominate; and the adult stage which can be understood in terms of psychic (astral) relations. These observations necessitate a clear distinction, in regard to the surroundings, between the general and the specific environments. The former is shared by all the species in the area of observation while the latter relates to individual animals. On the basis of the results of the study, the question of the 'Typusidee' is readdressed and the consequences for genetics and evolution outlined.

I am indebted to Craig Holdrege and Johannes Wirtz for the information on which the above notes are based. The article by Craig Holdrege in 'Elemente Der Naturwissenschaft' No. 45 was published in German: 'Schritte zur Bildung eines lebendigen Vererbungs begriffs'.

Articles on Dr. Bockemuhl's approach to heredity appeared in Science Forum No 5, p16 and p21.

Hadley Gange

MANUSCRIPT RECEIVED

"Constellations, Signs and Reincarnation - Tropical or Sidereal Zodiac", by Brian Dawes.

An article of this title was published in **Anthroposophy Today**, No. 14, Autumn 1991. A further treatment, containing a discussion of statistical and probability analysis to support the case, was offered to Science Forum, but it is too long to publish in this issue. However, a copy may be obtained from the author for a cost of £5 to cover photocopying and postage. Write to Brian Dawes, Burn Cottage, Burn of Benholm, Montrose, Angus, DD10 0HT

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