PRAISE TO THE PARASITES
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"The parasite is a pathogen. It causes a system's equilibrium or distribution of energy to fluctuate. It dopes it. It irritates it. It inflames it. Very often this difference has no consequences. It can bring about consequences — and by means of interlinking or reproduction they may even be immense."
(Michel Serres)

Obviously natural life results once a certain complexity has been achieved, making it possible to store learning processes as a text in a memory, which can furthermore copy this and convert it into instructions to build a machine. One of the essential features of life is, of course, not only to survive as an organism and, to some extent, to mend oneself over a certain period of time under suitable peripheral conditions, but also to be able to reproduce self-reproductively. Both imply a memory that not only stores digital and two-dimensional information but which also contains the instructions to form its own separate three-dimensional organism as well as new organisms. Due to copying errors and external influences or, in case of sexual reproduction, by joining together two memory texts there is the possibility that what is stored can change, whereby the survival chances of text variants by means of "adaptation" i.e. through internal reorganization, can increase.

Whether this implies an optimization in what is still the teleologically characterized language of evolution theory may be doubted, as there is no way whatsoever of tackling the criteria of adaptation beyond the banal statement that some organisms survive — that is that they "function," come to terms with changing reality and produce offspring. The talk of adaptation through the cycle of mutation and selection implies an assumed reality and consequently a kind of the classical truth relation of the conformity of cognition and the subject of cognition, which can hardly be supported any longer. After all, life itself changes its peripheral conditions, for instance, when it first built up the oxygenous atmosphere in the Precambrian through photosynthesis, which forms the basis of today's eukaryote life. Even the characterization of organisms as problem solvers is a metaphor, which nevertheless has a meaning in the generation of genetic algorithms as in this case the problem is specified here, and with that, a stable artificial environment. Embedded in the principles of evolution is, in many cases, also the idea of progress, that is the gradual improvement of populations through increasing complexity, although over 90% of existent living beings exist in the form of microorganisms. Most of them are harmless to higher living beings or even cooperate with them in a symbiosis, yet in the case of pathogenic viruses they are known to mutate at an enormous speed in order to deceive the immunological system that can generally produce mutations for resistance even faster. The immense variety of antibodies — we assume that there are 108 different kinds — is evidence of the wide variety of microorganisms which they have to provide protection against. Antibodies are produced from the mutation of a few basic structures and multiply like an avalanche in one variant once one antigen is entrapped by the receptors. In Man's immunological system and probably also in his neuronal network, the evolution mechanism is copied, strengthened and accelerated, in a certain sense. The higher organisms are therefore only the tip of an iceberg, populated by a multitude of microorganisms and parasites which, in the evolutionary armament race, still have the chance to destroy the more complex living beings through a lethal communication, refunctioning the programme of their cells.

Beyond the appraisal by means of adaptation, biological information vouches for a process which — within an unstable complex system that interacts with the organism carrying the information — can constantly have something new develop and let realized texts die, provided the environment is not stable. What is of course uncertain, is whether the "automatic" mutation of the genome in connection with selection is really of such importance for evolution as the classical theory believes it to be. For example, molecules which are only subjected to minute functional demands change much faster than those subjected to higher demands. It cannot be explained either as to why phenotypical change takes place faster with some lines than with others. And most multiple allelomorphs which arise as a result of mutation, get lost again by chance, whereby many mutations do lead to the formation of non-identical proteins which are present in a large variety in organisms, and however, differences very often reveal no phenotypical consequences. As a rule, mutations within the genetic drift either appear to be lethal or neutral, which would mean that influences from the environment or self-organization processes within the organism could be more effective than many may have assumed until now. Generally, transitional forms are missing, for example; breaks and bifurcations seem to happen very suddenly. Due to the fact that organisms themselves are very highly complex systems which integrate different levels of self-organizing systems, we could assume that transitions do not take place continuously, but rather erratically. The one-way street in the development from genome to organism also appears to be doubtful because, occasionally, as in the case of sea urchins or tree frogs, the sexually mature animals look almost the same and also have the same behaviour, yet their growth can be very different. In this sense, the larvae of very closely related sea urchins are completely different. Some can swim freely and eat plankton and others let themselves drift and can only nourish themselves on the ground. One could draw the conclusion from this that the pressure from the outside world is greater than the morphogenetic developments designed in genes. The fact that there is the complete set of instructions to form a three-dimensional organism in the genome appears, what is more, to be only undercutting the evolutionary approach adhering to the traditional linear computer architecture. As a result of probability theory considerations, the information stored in the genome cannot stipulate the instructions for every cell just as it cannot stipulate the three-dimensional form of a protein in a one-to-one equivalent. Perhaps the genome is to be understood more as a catalyst and morpho-regulator to form three-dimensional patterns and interactive chemical processes, whereas the localizing of a cell and its activity is determined from the location and activity of local cell collectives, i.e. on account of a surface communication between neighboring molecules and cells. The genetic code would then only give direction and limits for a development which itself would produce multiplicity and variability within the organism by means of the evolutionary mechanism and would enable a balancing of the different cell types evolving independent of each other. If one accepts such a concept, then the mechanistic intention of being able to derive the morphogenetic development of the phenotype from the complete mapping of the genome and its protein, control and structural code, and then even to influence it in a specifically differentiated way would be a phantasm. Even with non-linear algorithms the future behaviour of a computer in which hard and software are separate, different to biological systems, cannot be foreseen from the programme. When the relations between geno- and phenotype are not linear and are strongly based on the interaction between parts which are not controlled by a central computing and organization unit, then neither the three-dimensional organism nor its behaviour can be foreseen from the genetic programme.

The definition of life — ability of open metabolic systems to self-reproduce, to multiply, vary, and inherit — is known, as is the fact that the transition into the inanimate is not sharply marked but is smooth. Crystals can also be self-reproductive and mutating. On this ability, the chemist Graham Cairns-Smith built up his well-known and fascinating hypothesis on the origin of life through takeover. As DNA or RNA molecules are very complicated, he proceeds on the assumption that another replicator was here in the first instance, that is, simple inorganic crystals which self-reduplicate, such as are found in clay. As soon as the core of a crystal has formed spontaneously or a corresponding "seed" has fallen into an oversaturated solution, it can grow and become a solid, ordered shape. Now and again it falls apart and these parts also continue to grow. As chemical or mechanical imperfections can occur during the growth of the very regular crystal structures, which replicate with further growth, it also possesses a mutation mechanism whereby, for example, the growth variants can be transmitted to the "children" by breaking apart. Some crystals can grow faster and spread out, so what we find here is already a pre-form of evolution in which information is produced and passed onto new generations. At some time or other the growing, multiplying crystals began to produce organic compounds which helped them to survive. Cairns-Smith believes that these organic forms, which previously had been more of a tool, could have suddenly multiplied faster than the crystals following the appearance of a first self-reduplicating, simple RNA, and so moved slowly from the parasite status, which depends on a host cell, to become autonomous beings that had gradually put the crystalline life out of the running. Therefore, take over means that a part of a self-organizing structure makes itself independent and thrusts aside its pre-form. If this hypothesis is correct then new life could continue to develop from the crystal formation, a fact that we perhaps have merely not yet observed. Or perhaps the peripheral conditions have been disarranged through the emergence of life based on DNA and RNA. What also makes this hypothesis of take over piquant is the fact that a repeated take over is, in its turn, possibly taking place with the computers based on silicon, so that biological life would only be an episode in the life being based on silicon. After all, at the moment, so-called artificial life is already beginning to grow in the form of cellular automatons or computer viruses.

Even the molecular-Darwinist approach developed by Manfred Eigen proceeds on the basis of the thesis that selection mechanisms are already active in the inanimate area of material, so that life emerges from the self-organization of macro-molecules which are generated by entering into hypercycles. That is beyond every scientific explanation of how life came to be, and it is exciting because here it becomes clear that self-organization will emerge when various processes mutually build themselves up under certain conditions and "use" each other mutually, in a certain sense, whereby something new can emerge within the limits of the interacting forces. The new, in turn, provided it possesses the animated ability of storage and instruction, uses or "enslaves" the agents and integrates them, for example, as a cell does the mitochondria, a virus does the cell, a multi-cell organism the different cell types, or an organ the parasites, which always means that, under certain circumstances, the adopted agents, foreign organisms, or the very forces from the environment can turn around the ratio. The watchmaker would be blinder than the genetic evolutionary theory suggests to us. And the creative coincidence within evolution would not be apart from changes in the environment relative to the organism — essentially determined by chance gene mutation, but would result from the interactions not foreseeable in detail between populations (molecules, cells, viruses, bacteria, etc.) amongst one another and with each other.

A prerequisite to evolution is a stipulated variety of different, at any rate, non-identical self-reproducing complex systems, because only then can selection appear as a creative mechanism. Contrary to the usual pictures of the evolutionary tree with a trunk ramifying to show diversity only in its crown, this would speak for the fact that there are a lot of branches even at the very origin, that one cell and then even multi-cell living beings often emerged independent of each other. Besides the two lines of organisms — the animals and the plants — we have found yet another: the archaebacteria. And so one is forced to appoint the ancestor of life as being even lower than with the prokaryotes. The variety of bacteria is, however, enormously large and no one has ever succeeded in constructing a pedigree from the various forms, metabolism types and environmental adaptations. They are not differentiated enough for this and probably they very often emerged in parallel or one after the other. Evidently, different bacteria can also communicate with each other, by exchanging gene strands in a first step towards genetic cross over, which stabilizes a type with sexual mating, thus recombining their DNA plans at random. Bacteria could therefore have a general communications system whereby they could even exchange DNA pieces with plants and animals. It is assumed, for example, that the eukaryote cells which contain a core with DNA and smaller membrane-limited subunits originated from a symbiosis with prokaryotes with only one single DNA ring. And even the eukaryote cell core appears to contain at least three types of genes, so that it could be a chimera of DNA texts. In addition to this, there are still the viruses which normally do not count as living organisms but which already have strands of DNA or RNA and which are surrounded by a protein coat. Unlike the organelles which similarly have their own genetic code, they have not integrated themselves in the host cell which can be understood as being a cell of cells, but keep their information by infecting cells and by refunctioning them for their multiplication. Until they tap a corresponding cell and its gene text and have it work for them e.g. by adding their genetic code to that of the host cell, they are in an idle position and are "lifeless." Therefore, viruses can either envelop the programme of the cells or directly change it in the sense of a genetic take over. From these many interactions of acquisition and parasitism one could assume that parasites at least accelerated evolution and that the battle between parasites which developed parallel to the first living single cell organisms, and host cells started up a significant, creative but, of course, also deathly mechanism. Without bacteria any higher life could not exist. Even viruses belong to the environment of living organisms and evolution do not appear to reward single individuals or single gene pieces, but rather populations which are in cooperative interaction with each other, including even relationships between parasite and host organism or animals of prey and hunters. if the niche is too simple and the organisms are not threatened, then very often no further development takes place. Instead there is a reduction in the programme.

What is interesting in this respect is that artificial life celebrated its first, even in many cases, unwelcome successes with the so-called computer viruses. They have a programme just like biological viruses, i.e. a memory storing information which, having been infected, uses the computer as a host organism to copy itself into another computer and to be able to multiply. In the computer ecology viruses act autonomously and they communicate with its programmes what does not necessarily mean that they damage their host organism and the niche of interlinked computers with their ever increasing data clearances. For example, Harald Thimbleby programmed self-reproducing viruses which he called "lifeware" in such a way that they compare data banks. If these data banks do not correspond with each other' the missing data is automatically copied into the other data bank. Fred Cohen even believes that symbiotic computer viruses could, in future, take care of the main work for subordinate tasks in information systems. Nobody really knows — as with genetically changed microorganisms — if they will continue to be "kind helpers," once they enter into an evolutionary drift. However, as yet, most viruses have not been programmed by system users anyway. The computers are infected externally with more or less damaging viruses. The consequence resembles a kind of armament race: computer systems are better safeguarded and viruses accordingly become more intelligent. It is assumed that sexual mating has managed to succeed in biological evolution, amongst other things, because the interference from bacteria could be fended off better. Of course, there are still merely rudimentary forms of mutation by means of which computer viruses can adapt to new surroundings. Their evolution is advanced by human programmers, but it will probably soon be possible to develop and release computer viruses which can change in order to escape the search programme and to adapt more flexibly to new surroundings.

In the case of genetic algorithms which use the evolution mechanisms of selection, mutation and genetic crossover by mating in order to optimize programmes for solving tasks, the structure of which need not be recognizable in detail, populations of non-identical programmes or chains composed at random of zeros and ones will be exposed to a solution space and then assessed in accordance with their quality. Programmes are a bit code composed of rules to recognize features and to trigger off actions. As genetic algorithms are organized non-linearly so as not to reduce them to a dominant rule arid thus make them unsuitable for complex situations, the rules also compete with each other and all the rules which were involved in a "successful" action are rewarded, i.e. amplified. Such programmes which gradually organize themselves heterarchically and hierarchically can be very flexible, but of course’ they are exposed to a rigid environment and are assessed from the outside. In addition to this’ their populations are generally still very small as compared to biological ones. Their advantage is that they can pass through the generation sequence at high speed and evolution can be observed’ whereby all development stages and impasses are stored’ a feature which is different in the biological one. The increasing capacity of parallel computers — the "Connection Machine" by Hillis was, incidentally, developed within the context of researching artificial life — means that programme populations will be able to be bred, that will sufficiently come closer to the individual number of natural populations. Although, with genetic algorithms which can again be compared to viruses, really new construction plans or behavioural modes can emerge, particularly as a result of crossover, John H. Holland points out that even here phenomena such a symbiosis, parasitism, mimicry, predator-prey coevolution, niche formation and the fissioning of one kind into new stem lines can be observed. Incidentally, in the case of genetic algorithms it has been shown that the mutation rate as opposed to cross over was an almost negligible value for evolution. Genetic algorithms and cellular automatons are restricted in their self-organization, particularly by the fact that they do not exist in a complex environment, even if they are in a position via back-fed processes with no superordinated rules, to produce relatively complex collective behavioural modes from the reaction of individual "organisms" in locally restricted situations.

The fact that the existence of parasites, and therefor, the genetic takeover, could have been an important catalyst for the variety and complexity of life — and possibly even still is — was illustrated by Danny Hillis in a computer simulation on one of his Connection Machines with 64000 processors operating in parallel. He sent "organisms," i.e. binary number chains representing genes which were to solve computing tasks on the basis of genetic algorithms, into an evolutionary armament race with parasites, which were similarly rewarded if successful. These types co-evolved by reacting even more skillfully to the attack or defence strategies. Always when the organisms had stabilized and had immunized themselves and it seemed as though the parasites had lost the race, a wave of attackers suddenly emerged again which managed to breakdown their safety systems. Hillis discovered that during the phases of standstill in the case of the phenotype, defined here by its computing abilities, changes were already taking place in the digital hereditary material which suddenly caused an even greater change’ as from a critical point. Evolutionary biologists have always observed this change between periods of standstill and rapid innovation at the level of the phenotype, but they cannot explain how this sudden change which is in opposition to the dogma of change by means of the accumulation of small steps, takes place. What was noticeable was that the organisms needed a lot more generations in order to optimize, when there were no parasites in the computer top. Consequently, their presence accelerates the evolution process and the variety by keeping it at the brink of chaos, that is, providing for imbalance. Even the erratic innovation with parasites and organisms can be thought of as a take over. First of all, alleles are produced which are either neutral or which could be used for other functions, as in nature’ it is not the principle of identity but more the flexible one of similarity which dominates. If there are a number of alternative genes available which cause another behaviour through feedback, that has "advantages," a new feature resulting from mating could spread out erratically.

With "Tierra," the biologist Thomas Ray tried to design an evolving system where digital living beings which had been changed by different mutations of their hereditary material were competing for processor time and storage space. The environment also changed through a kind of computer noise and the organisms of 80 gene-commands only had a limited lifetime, i.e. even the well "adapted" had to make their exit at some point. After the system had been running for some time and mutants emerged which worked even more effectively, organisms with only 45 gene-commands suddenly appeared that were unable to reproduce. For this reason, the parasites had to look for a host in order to use its replication code. As they were simpler, they were able to spread out faster than the more complicated living beings. But if they had alienated and killed too many hosts' their numbers also went down. With parasites there emerges new peripheral conditions between living beings developing an evolving system, to a certain extent, like a catalyst and out of which even mutants which could not survive in a stable environment with a constant solution space get a chance to survive by a mutual armament races.

Parasites appear, therefore, to emerge with a certain complexity in the course of the evolution of life and further advance this, irrespective of if this takes place in the sense of an armament race or as a symbiosis. There is a huge variety of parasites of biological life, probably their types exceeding by far those of all other animal species. Larger parasites display a wild multitude of metamorphoses and exploit an incredible series of intermediate hosts. Parasites are predators and guests which knock a complex system off balance and cause change: they are agents of metamorphosis, open up evolution to unforeseeable developments which otherwise only occur as a result of catastrophes in the physical and chemical environment. They very possibly not only interfere from outside, damaging or improving an organism, nesting into it or providing for noise, but also introduce direct mutations of the hosts through their information work. Their behavioural features are not restricted to the parasites which penetrate a host, living in it and playing with its memory, as every form of take over and creation is parasitical, whereby even the hosts can be termed as being parasites in an intricate network. After all, life is a parasite of the earth which has been invaded and changed by it. And every host that is occupied by parasites, is, in itself, a parasite of another living being inasmuch as it lives off other organisms.

If the RNA or DNA were perhaps parasites of a life based on silicone, then they themselves have subsequently become parasites of the host cell they use as their survival machine and in which the neuronal system has possibly developed as a further parasite, again becoming a host of a new life form yet which is already the carrier of that form of life termed culture. But even the evolution of a new behaviour based on the sequence of many motoric and sensoric actors and millions of neurons competing and cooperating with each other, can be understood as being a take over and consequently, a parasitical use of previous simpler behaviour sequences of the neuronal machinery that, as yet, had been set in a completely different solution space. In this way, as the neurobiologist William Calvin assumes, the senso-motoric behavioural sequence of precisely hammering open nuts with stones could have been used to make possible the throwing of stones at moving targets. This ability to organize different back-fed sensoric, projective and motoric behavioural sequences in an intersecting "melody," by the selection of many variants played through and assessed in milliseconds, could have opened up the possibility of building up a differentiated language from complicated interlinkages, with the same sequence mechanism permitting the playing and writing of music. If the parasitic take over succeeds, new niches emerge which continue to develop in parallel becoming more complex with the emergence of new parasites emerge that challenge routine behaviour generally through choc-type complexity reduction.

If there is an enclosed environment and a rigid solution space as in the virtual world of computers, then parasites can obviously be used to optimize algorithms. They could then be of importance for the continued development of artificial intelligence on the basis of genetic algorithms on parallel computers and the bottom-up method determined by chance. However, there is always the limitation that they also cause systems to crash and can introduce an uncontrollable development. We must get used to the fact that balance is not an orientation by which biological, psychical and social systems keep themselves alive, that it is more the introduction of nasty, destructive viruses and parasites that produce new forms of life' thinking and art. We should not accept the bad merely as a drive, we possibly have to produce it ourselves in order to survive, meaning that to change the animate and inanimate environment in which, and from which we live as parasites. Irrespective of whether we biologically supersede ourselves in the long term, or in the short term by gene technology, or whether we release a post-biological life that will leave us behind in the armament race but where we, perhaps, could continue to live symbiotically or by the fact that we invent new knowledge and technology mutations, we will bleakly be forced to recognize that we are not the stable final product of evolution that we can steer and control from the outside. And even if we could succeed in throttling certain developments, perhaps with regard to AI, AL or gene technology, we would end up in another evolutionary drift which is just as unforeseeable and which is immune to sudden mutations allowing new parasites and viruses to emerge.

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