The Bio(technological) Melting Pot

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'Man's biological evolution is characterised by the subsequent 'liberation' of his body from constraints (ape-like gait, prognathism, limited manual dexterity) that impeded 'external' evolution, i.e. technical and social evolution. Is it possible to project this process into the future? The evolution of a body is not infinite. Some species have achieved a kind of stability, others have died out permanently. The odds for man are of the second type, and if it were any mammal, the prognosis for the next ten millennia would be categorically pessimistic. We can also speculate that, through voluntary action, he will make use of genetic laws to suspend the catastrophic course of his evolution. However, we cannot see what he could still 'get rid of' without changing species.' (Summary from André Leroi-Gourhan, The Gesture and the Word, 1964

'The process of creation is by no means concluded. No one can predict what will happen in negligible time compared to the stages of genetic evolution. Today we are able to interfere as 'repairers', whereas creative intervention would require knowledge that we (as yet) do not possess. However, evolutionary progress in the near future is unlikely to take place on a genetic level. Man's mental evolution has put the evolutionary carousel into rapid rotation; almost everything that will take place in the not too distant future will proceed from man. We will only be able to master this problem by mobilising mental resources, but their ethical component has failed to keep pace with the rapid growth of science and technology'. (Manfred Eigen, Steps to Life - Prebiotic Evolution in the Light of Molecular Biology, 1987).

Programme

In the last issue we warned the reader with a premise: one cannot tackle the problem of biotechnology without shaking off the ancient hybris, the atavistic fear of superimposing oneself on God's prerogatives. Despite the warning, we are well aware that we must persevere and, as always, we lay our cards on the table beforehand.

We are not doing research. This has already been initiated and accomplished by a well-defined current within mankind, a current that only by convention we trace back to a few names of individuals who grasped the peculiarities of the new science by making relations, discovering laws (Galileo, Darwin, Marx, Einstein, etc.). Rather, we are in the realm of further demonstration on the basis of acquired knowledge, whereas new knowledge will only be within the reach of mankind when the social obstacle that today prevents its development is broken down.

God's prerogative is the creation of the world, especially the living world, aimed at the appearance of man. Man's prerogative is the production of the world around him, according to purposive projects (the adjective would be useless, but the tautology serves to distinguish the human project from that of the animal constructive instinct, bees, termites, beavers, etc.). Man would therefore, within certain limits, already be able to design his future, to finalise his activity to a desired result, as when he designs a building or a plane. As when he will be able to design the harmonisation of the biosphere instead of indulging in its destruction; or, if he deems it useful and opportune, to design organisms not only genetically modified but of a new species.

Note that while metaphysical finalism has been variously adopted by idealist currents, a determinist finalism is consistent with the materialist conception. There is some confusion about the terms, since some philosophers such as Bergson and some scientists who rediscovered it have taken up metaphysical conceptions, but today it is generally accepted that the problem cannot be reduced to a mere question of language: all deterministic processes, including chaotic ones (we say that deterministic dynamics is nature's way of being) are 'finalistic', since in an elementary chain of events what precedes is in fact the blueprint of what follows. Statistical indeterminacy has its solid foundations, especially when many chains of events intersect, but it does not undermine determinism, which shows us every dynamic as a bi-directional phenomenon (i.e. theoretically knowable forwards and backwards in time).

This will help us to understand the profound nature of biotechnology beyond the chatter, because the process of life is decomposable, in the sense that it is possible to 'disassemble' what nature has composed over time and 'reassemble' it according to other criteria in order to obtain desired results. The complexity of living phenomena obliges us to warn the reader against a reductionist reading of the problem: the manipulation of molecules in the laboratory can only be treated like the game of ‘Lego’ from a descriptive point of view, while our dialectical conception of complexity remains intact, i.e. that sets and details of ‘pieces’ undergo qualitative changes that are not in trivial relation to their sum or division.

The general basis of the concept of bi-directionality is still that laid down in the 18th century by d'Alembert, whose fundamental formula on wave motion demonstrates the reversibility of processes: if we know a phenomenon, we also know its future evolution and, at the same time, precisely because we know it, we know how to investigate its past. Physicists investigating matter in the last century, i.e. in the first half of the 20th century, faced enormous obstacles due to this type of problem, including ideological ones, when they had to deal with wave-particle ‘dualism’. It was precisely the use of a formalism like d'Alembert's that allowed them to proceed with powerful and adequate cognitive systems. After all, the standard cosmological theory, that of the Big Bang, is based on the investigation of the characteristics of the universe conducted both backwards - i.e. on the origins - and forwards, projected into the future (there are many theories and none can explain all the observed phenomena, not even the standard one).

It should also be pointed out that a large group of dissipative phenomena, without reaching the sub-atomic level, seems to escape this type of consideration, i.e. they do not seem to be treatable according to the strict procedure of deterministic formalism. Some have induced theories of indeterminism, attempting to prove the irreversibility of almost all phenomena of nature. Others have tried to show that determinism is not affected either by probabilistic laws (if there is a law, there is no indeterminacy), or by chaotic phenomena, or by singularities or cusps that entail great computational difficulties. We obviously belong to this second group.

The phenomenon of life, which is the one we are dwelling on in biotechnology, is the most contradictory of all. On the one hand, it seems to be linked to characteristics of indeterminacy and irreversibility more than many other phenomena of nature, and therefore linked to chance; on the other hand, being based on a genetic programme that faithfully reproduces itself, it seems to give reason to the advocates of the creation, if not of Adam, at least of man's primordial genetic programme, including its finalistic potential due to the mutations that would already be implicit in the programme itself, regardless of its relations with the rest of the world.

Poetry, materialism and that idealist Marx

In the field of molecular biology, as in the rest of society, hypotheses and theories are produced that can be seen as a cloud formed by contradictory points around an unambiguous direction that represents the future consolidation of a recognised, shared and verified theory. Following the teachings of those who have gone before us, we work on the distillation of positive and negative examples, looking for or establishing relationships between the various materials. Thus, on the basis of our schooling, we discard the advocates of creative chance and consequent necessity, while linking up with the advocates of the continuous process, of the accumulation that produces sufficient potential for revolutionary explosion, precisely the discontinuous solution we often speak of. Represented, in the case of biological phenomena, by the appearance of life and the subsequent modifications that have produced the enormous variety of animal and plant species.

Man has therefore accumulated an enormous potential for change, not only on a technical level but above all on the level of the socialisation of labour, which prompts him to address - on the threshold of the radical transformation of society, having prepared all the technical means useful for the future, developed the sufficient strength of the social brain outside his body, refined not least the appropriate theory - also the problem of biological evolution as a fact not to be left to the millions of years to come. The evolution of human man (i.e. the one distinguished by the high socialisation of labour) has proven to be immensely faster than that of animal man, and the consequences are before our eyes, beyond the liturgies associated with the dying old world.

This evolutionary movement could not fail to have repercussions on men's brains, and one must also be able to read in the lucid madness of a Nietzsche who, contrary to popular opinion, predicts not the advent of the Nembo Kid, but of the Übermensch, the Überman, a *'species of a superior type, with other conditions of production and preservation than the average man'*. This literary theme is also consistently developed in Stanley Kubrick's famous Space Odyssey, where the representative of the old species stops juggling desks, flags, Christmas families and machines made hostile, to finally meet the super-idealistic monolith, i.e. his own agony, as the new man arrives, a foetus with two big eyes like this, with the disruptive music of Thus Spoke Zarathustra for background.

The progressive philistine does not like being fed 'certain metaphysics'. Since he wallows in vulgar materialism, that is, in the crude communism of democratoid capitalism (the generalised, levelling envy of competition), he does not feel that poetry can only say in other words what science has already said. So we will provide him with St. Karl's quotation so that he doesn't break the bank:

*'The real historical relation of nature, and therefore of natural science, to man is industry; therefore if this is understood as an overt revelation of the essential forces of man, the human essence of nature or the natural essence of man is also understood. Consequently, the natural sciences lose their abstractly material, i.e. idealistic, direction and become the basis of human science, just as they have already become the basis of real human life, albeit in an alienated form. Therefore, to say that one is the basis of life and another is the basis of science is a lie from the outset. The nature that becomes in the history of man is the real nature of man, so nature as it becomes through industry, albeit in an alienated form, is the real anthropological natur*e'.

And here is the concluding 'finalistic' touch: *'For communist man all so-called universal history is nothing but the generation of man through human labour, nothing but the becoming of nature for man'* (Manuscripts of 1844).

Industry in general is thus both product and factor of man, just as stone industry was product and factor of the hand and brain. It is one with the history of man and, just as it includes the chipped flint, it also includes the steam engine, the automatic weaver, the computer and biotechnology. With industry, man has accelerated evolution, which now takes place outside his body without waiting for the latter. Knowledge is no longer transmitted solely from parent to child in a direct, limited biological relationship (the seed, the word), but instead through universal tools such as writing, libraries, schools, databases, computer networks.

The problem therefore does not lie in biotechnology in particular, just as it does not lie in any other industry in particular, but in man's entire activity in relation to nature. It is this overall activity, not one of many chosen according to the trend of the news, that can no longer be left in the hands of capitalism: it is too dangerous for the very survival of our species, not just its 'health'. Like any other species, ours is not exempt in principle from the danger of extinction.

Such an issue cannot be a subject for parliamentary debate. When the 16-volume British government report on mad cow disease (BSE) was finally unveiled after four years, the Economist wrote:

'It is one of the most profound demonstrations ever produced by slow government progress. Like the whole BSE saga; it manages to bore, shock, disgust and terrify, all at the same time. The science of the disease is too complex for most laymen to understand'.

But it is not complexity that prevents comprehension, but the overlapping of opinions tainted by political interests, the very ones deposited in the 16 volumes, supported by quotations from experts who, called upon and paid by one camp and another, could only add opinion to opinion.

The structure of the modern scientific knowledge of the bourgeoisie itself allows us to unmask its representatives when they take sides in the biotechnology debate. In the face of the bluster of supporters and detractors alike, this knowledge is able to show us that they lie in the vast majority of cases and that their battles take place in the realm of ideology and not in that of actual facts. Bourgeois epistemology is not enough for us, but it is an achievement from which we can start to criticise it. It, for now generally accepted except in debates, tells us that a phenomenon is known when, starting from an initial situation, a subsequent result is arrived at through an observable, describable and thus reproducible process. A process that we can know in this way, we have seen, is by definition reversible, i.e. we can indifferently start from the end result to reconstruct the process itself and know the initial situation. This is the case in the great generality of cases, even if in fact nature presents much more complex and dialectical situations than those that man necessarily represents in his models. But the concept is sufficient for now with respect to what we want to say.

If, therefore, it is claimed that a cell modified by the application of genetic engineering is not dangerous because it is of the same nature as existing cells, it must be possible to describe the process by which a cell can become dangerous, at least potentially. The fact is that nobody knows what the difference is between a potentially dangerous cell and a harmless one, since the mechanism of mutation is not known. It is known that evolution had to entail modifications so that from an elementary virus-like form we went from single-celled organisms to multicellular organisms and, taking much less time, from a primordial amphibian to man; but no one has ever discovered what happens in natural genetic engineering when the programme, which is supposed to be in charge of the stability of a species, produces a new one instead.

Of two human tissue cells, made of the same atoms and molecular chains, with the same genetic make-up and therefore absolutely the same, at a certain point, under identical 'boundary' conditions, one becomes mutagenic and the other does not, without anyone in the world, as yet, being able to recognise, in advance, which one has mutagenic potential. Not even a cell that has already been modified gives us, even after it has reproduced itself several times, any indication of what has caused it to mutate. If a laboratory test could establish the difference, we would have at our fingertips the solution not only to cancer but to all the problems associated with the reproduction of cells through their genetic code, and we would probably also have discovered the mechanism of life. We know of the existence of conditions that favour mutagenic effects, as in the case of carcinogenic situations, but we know nothing about the process whereby, between cells subjected to the same conditions, one mutates and the other does not, with very pronounced differences between individuals.

The same criterion applies if it is claimed that genetic engineering is dangerous. The solution in any case cannot be to prohibit research, or even the so-called precautionary principle ('if I don't know, I prohibit'): in man, doing and knowing are generally the same thing, with the difference that capitalist man translates this dialectical union into something absolutely trivial by pompously calling it 'experimental research': he often does it at random, to see if he can find something, especially funding that will guarantee him a steady wage. There is no point in forbidding him to be like that, it would be like forbidding him to be involved in the capitalist mechanism.

Do not interfere with life! But what is life?

When we speak of 'life' a problem immediately arises, not so much of definition as of appropriate terms: we do not have a word for non-life. Dead is an organism that was previously alive; inanimate is an object defined by comparison with the living; mineral is also the component of the biological; physical world is everything, since the living like the non-living is made of the same elements.

This linguistic difficulty is an important demonstration: man has not had time to wrest from his mind the ideal categories of two previous revolutions: the feudal revolution, which took categorisation to its extreme consequences, and the capitalist revolution, which laid the foundations for mechanistic materialism, even though it reached higher peaks by defining life as an organised state of matter (Diderot). The communist one, which is already mature, has enormous difficulty in finding its own language.

If we are unable to define an unambiguous transition from matter to life, and we do not yet even have the language to speak about it with propriety, then we must first of all admit that when discussing biotechnology, feelings of hybris should not be involved. Just as such feelings - usually - do not come into play when discussing mechanics, chemistry or physics (unless there is some evocative word like 'uranium', as we see in another article).

The 'lowest' rung on the ladder of life is the virus. From the point of view of modern biology, it is nothing more than a molecular complex, known well enough to be theoretically synthesised artificially. Its structure is so simple that when crystallised, it cannot be distinguished at all from minerals. And yet, if it encounters a host-cell, it behaves like any living thing: it self-reproduces, starts an activity of replacement, adapts to the environment by assuming the ability to mutate.

The virus, a non-life that becomes life when it enters into symbiosis with it, is a form of transition that allows us to understand a little better what we are discussing:

1) life is an ordered state of matter, it contains information;

2) the information of order must somehow reproduce itself;

3) to do so, there must be an exchange of energy with the environment;

4) the reproduced information must change to give rise to evolution.

All these conditions are encapsulated in a molecule discovered only fifty years ago but now fairly well known, DNA. It is the programme that 'informs' every characteristic and every stage of growth of all living organisms, bar none.

From this brief premise, it could be deduced that man is capable of synthesising an 'artificial' life project. Indeed, it would be enough to be able to synthesise the programme contained in the DNA molecule to obtain a living organism. If the biotechnology industry were to achieve this result, it would be, as far as that field is concerned, in the conditions described by Marx: nature-man-environment made industry would reproduce itself in a finalised becoming, i.e. according to plan, 'albeit in an alienated form'. Much more than automatic machines and computers, biotechnology interpenetrates man and nature. Nature would not have to wait millions of years for new species to appear, but would simply produce those it needed through itself. As when it selected species through millennia of mutations, with the difference that now man's conscious design would intervene: one of the many cases of 'reversal of praxis'. Even a city, a whole society, is an 'ordered state of matter'; only for now, the project is not overall, it concerns individual details such as a house, a railway, an electricity grid. The human species does not yet have its social DNA, a programme for all the diverse functions of that space-travelling organism we call Earth.

In any case, it is highly unlikely that this society can fully understand the mechanisms of life to the point of replicating it from its constituent elements. The goal is still a long way off because a logical paradox arises: to build the molecule that contains the information of life, we would need the molecule itself and the entire enzyme complex that presides over the transcription and decipherment of the 'language' needed to produce it. To put it simply, it is the chicken and the egg problem. However, while this mode of production persists, knowledge is aimed at results that produce profit, and this can be achieved even without reproducing life, the reproduction of pieces of life to put on the market is enough. For the same reasons, it is absolutely impossible for capitalist man to conceive a plan for his own existence in harmony with the biosphere: capitalism demands nothing more than to continuously produce saleable goods.

Today, laboratories are using the knowledge gained from viruses and applying it by grafting portions of the genetic code, mere molecular chains, onto natural host organisms in order to obtain modified organisms or replicas of existing cells. In this way, it has been possible to obtain plants particularly suited to the capitalist cultivation cycle (hyper-productive, resistant to herbicides and parasites, etc.) and also to replicate (clone) certain types of animals. With the same techniques it would then be possible to intervene on many characteristics of the human organism and even achieve its complete cloning. For more than twenty years, well before it came to this, the debate on the ethicality and dangers of genetic engineering has been raging. Almost always out of hand.

Man, nature and 'danger'

If we adhere to the canons of certain environmentalists, man should be wiped off the face of the universe: no living organism alters nature as much as he does, as profoundly and, above all, as quickly. Nor could he do anything different without renouncing his being man and not animal. Yet it takes little to realise that through man it is nature that modifies itself. The criterion of distinguishing the damage that man can cause from that which other organisms can cause is in itself logically correct: no animal makes atomic bombs or even 'only' petrochemical plants. Our means have indeed become too powerful compared to the ethics we can average. So what? It is easy to answer that mankind probably does not need atomic bombs (although, in a film, mankind is saved by using them to blow up an asteroid on a collision course), but it is not as easy, nor is it correct, to apply the criterion to everything else.

To biotechnology even less so. The reason for this is that genetic engineering intervenes in life processes in a less devastating and more controlled manner than industrial chemistry and all those causes that provoke deadly cocktails in the biosphere in which we live; as the case of BSE, among others, demonstrates, where a chain of concauses was set in motion for social reasons: a disease of sheep already caused in the 18th century by inbreeding to improve production passed on to cattle and then to man due to the industrial feeding system that imposed a meaty diet on herbivores. And these facts have been known, if not perfectly known, for at least twenty years.

Perhaps one day man will move on to the creation of new life forms, but for now he can do little compared to nature in the field of biotechnology. As usual, we are faced with a scientific bluff, amplified by the media: today, the biotech industry is dedicated more to perfecting genetic hybridisation techniques by copying nature. The difficulties that arise in the face of such an undertaking concern how to copy, because that is all that is needed for now. Nor is it certain that the knowledge that is still lacking is worthy of attention from the point of view of making a profit, simply because, as far as recombination mechanisms are concerned, nature already offers everything that is useful for the production of genetically modified organisms for the market. Popular belief sees man manipulating organisms at will, if not now perhaps in the future, by means of recombinant DNA, which is the basis of experiments in this field. This is not at all what happens in the supersecret and feared laboratories of the prevaricating multinationals.

Admirable result, but of nature

The most elementary living organisms, just above the virus such as colibacteria, possess genetic information consisting of a few million 'symbols'. Such organisms reproduce within a few minutes, during which the entire information is 'read' and the synthesis procedure necessary for reproduction is carried out. At mammalian level, reproduction requires the reading of a thousand times as many symbols, and the complexity of the execution of information is multiplied by the fact that male and female inheritance is also at stake here.

The localisation and manipulation of genes would require the ability to precisely identify a certain segment of the entire information, extract it and reuse it for the desired purpose. For billions of years, nature has been able to do this very well; man has not been able to do it at all so far, and some question whether he will ever get there. Genes are molecular structures, so we are talking about phenomena occurring at the atomic level, where any intervention produces all kinds of perturbations. On this terrain, the task, taking into account the possible combinations of billions of symbols, since it is enough to get one of them wrong to end up with nothing, is practically hopeless.

Nature succeeds in this by means of particular enzymes, called restriction enzymes, each of which has a specific recognition signal with which it localises the corresponding segment of information in the gene complex. Man does not need to invent recombination techniques, he only has to fine-tune the natural ones he has discovered. So the tools used in biotechnology are natural. With them, it is possible to 'engineer' the transfer of DNA sequences, parts of genes, complete genes or combinations of several genes from a donor to a receptor. When one and the other are of the same type, a gene transplant is like an organ transplant: the defective one is replaced by an intact one. Genetic diseases can be cured by this route.

The natural process has been consolidated over billions of years, and in this time nature has 'experimented' in the vast laboratory of the Earth with more combinations than man can ever verify in his own laboratory; therefore, using the same processes, it is excluded that unwittingly created organisms, moreover harmful ones, could result. In a bacterium, and even in a virus, the pathogenic potential required a very long specialisation, the random reproducibility of which is pure fantasy, since it depends on probabilities written in numbers inaccessible to our minds. Some argue that it would be a different matter if someone, for military or terrorist purposes, were to recombine the DNA of viruses or bacteria in a targeted manner in order to increase their pathogenic efficacy; others retort that such pathogens exist in nature that it would at least be uneconomical to start making new ones.

However, viruses and bacteria are particularly well suited to receiving large DNA segments, so they are normally used to 'contain' complete sequences of certain organisms, which are then segmented and hybridised with other genetic segments of different organisms via the enzymes already mentioned. Pathogenic replication of viruses within the cell is prevented by inhibitory genetic treatment.

In this way, archives of gene sequences that can be sold on the market are created, or substances used by pharmaceutical companies are produced directly. The production of human insulin by means of colibacteria, for example, is nothing other than the production of a natural substance by natural methods. From a scientific point of view, it is the same as making wine or baking bread. The allergic reaction that, for example, insulin obtained in this way triggers is controversial: according to some, it is not qualitatively and quantitatively dissimilar to the reaction that one can have to drugs, foodstuffs or various substances; according to others, it is proof of the harmfulness of genetic engineering in general.

Manipulations at all levels

Slightly different is the programmed modification of organisms by transferring genes from one species to another, an operation that the media apparatus portrays to us as strawberries crossed with salmon or tobacco crossed with mice etc. This type of manipulation involves an atypical mutation within the species undergoing the treatment. Whereas natural mutation occurs at different times with the predisposition in the organism of certain precursor elements that will enter into a close relationship with the conditions dictated by the environment, artificial mutation intervenes directly in the genetic programme. In practice, time-consuming experimentation and natural selection are dispensed with and replaced by laboratory tests. The methods of recognising a gene and the 'translation' products that can result from it are well known, while uncertainties remain about the long-term effects, i.e. little or nothing is known about the interactions over time between the functions of the new gene, the overall characteristics of the organism thus modified and the surrounding environment.

Little is also known about micro-interactions between molecules independent of the genetic make-up. The prion responsible for BSE, for example, is a protein that, although it has no genetic make-up, manages to cause an alteration in other prions that exist in organisms without causing damage. It makes them the same as itself by varying just one amino acid out of 250. This simple modification alters the shape of the molecule, thus its behaviour in comparison with enzymes. The alteration is not genetic in origin but produces similar effects, which is perhaps why the modification of this protein does not alert the immune system. Moreover, that kind of alteration of the spatial arrangement in the molecule was completely unexpected compared to what we know, so the discovery is in itself important for the investigation of the mechanisms of information transmission at the sub-cellular and even sub-viral level. If it turns out to be true what is emerging in England, i.e. that BSE and its human variant are not due to animal meal but to mineral imbalances induced in the body by various environmental factors, every area of human nutrition would be much more at risk than previously assumed. Indeed, it cannot be ruled out that there are genetic mechanisms due to causes other than the information fixed in DNA, even if they are controlled by it. Such a hypothesis could better explain the occurrence of mutations and thus of nature's evolutionary processes, but it could also - precisely because of this - mean that if genetic manipulation is not exempt from very serious dangers, the level of spontaneous alteration achieved in human-environment interactions is perhaps even more serious.

It is a fact that large multinationals claim to operate with the utmost safety, but they say the same thing in the case of large petrochemical plants and nuclear power stations; just as governments have been reassuring populations for years about meat consumption and the nature of prions that cause mad cow disease. There is no difference, in this respect, between traditional and biogenetic industry.

However, organisms are also altered in nature. In the past, natural alteration was slow, now it is faster. In the biochemical brew that has become the entire planet, nobody knows what is really going on. The likelihood that specific molecular chains capable of being harmful in themselves will arise in the living world is low, but the deadly cocktails of substances that are concomitant in the generation of various diseases, especially cancers, are an everyday reality. And it is a proven fact that cancer is due to genetic mutation almost always induced by external factors. Micro-organisms become resistant to antibiotics both in a forest, which produces them spontaneously, and in a hospital, but of course it is quite different the mild progress of phenomena in the wilderness from that in the super-concentrated mass of humans, bacteria and antibiotics of all sorts represented by a large hospital.

From a theoretical point of view, there is no difference between classical seed selection, the hybridisation of farm animal species or the crossing of plants by farmers, and laboratory genetic manipulation. On the contrary, since the former is less programmed, it is in theory more risky for the ‘improved’ species and the environment than the latter.

In reality, the improved species we have been feeding on for millennia, even though they may have facilitated, for example, the spread of specific parasites or the intensive exploitation of the soil, could at best reintroduce themselves if they were not cared for in reproduction, whereas the horizons of laboratory genetics are still somewhat indistinguishable. However, gene-preservation and transplantation techniques are as yet unable to produce planned - and thus predictable - modifications of entire organisms, let alone design new species. Undue alchemy is also attributed to genetics. It is on these issues, especially when it comes to the manipulation of human genes, as in the case of the now famous embryonic stem cells, that the ethical taboo is triggered.

Yet all these techniques increase our knowledge of nature and can be turned on its head in favour of human-nature harmonisation. But is it possible to know these processes to the full so that we have control over them in the future that is useful to the species? The programme that establishes the nature of an organism, its interactions with the environment and its hereditary traits, is made up of hundreds of individual genes, the combination of which forms the genome. Each gene, having been formed and adapted over very long periods of time as part of the overall structure of that ordered matter we call life, constitutes an instrument that has become optimal and efficient for the functions it has come to perform. The gene, like the cell, like the individual, like the human species within nature, is an integral part of a whole with which it has always interacted (that in this there is also an analogy with the organic conception of party is a theme we have developed several times elsewhere).

Deep knowledge of organisms, therefore, should start from the structure of their genome. Not only from the classification of parts, which is in progress for several organisms, but from the entire network of relationships between them. Such a task is too arduous even for the human imagination, which normally works very hard. 'Too much' in the sense that, while it is possible to establish the number and function of genes, the number of relationships between their molecules is beyond the scope of our brain's perception. A single gene is composed of, say, a thousand symbols; the number of alternative sequences that can be obtained by simply swapping between them as occurs in nature is 10600, which is a quantity impossible to relate to anything known.

The universe, physicists say, came into being 1018 seconds ago, and the total matter existing in it corresponds to that of 1074 genes of the type we have taken as an example. If all the matter in the universe had been used, from the Big Bang onwards, i.e. for five billion years, to produce only nucleic acids, genes of precisely 1000 symbols in length, and if these genes were broken down and reconstituted into new sequences once every second, only 1092 sequences would have been tested to date, i.e. an insignificant proportion of those possible. On the other hand, the mass of the universe compared to that of the earth is only 1028, a ratio that in itself would rule out the possibility of sufficient recombinations to give rise to information complex enough to generate life from its fundamental genetic components.

These are the numbers that biotechnologists are wont to cite, partly to amaze the public and partly to make it clear how complex the subject they work on, earning their salaries, is. But above all, they use them to demonstrate, curiously enough, two opposing things: 1) that life has not had sufficient time to 'try out' all possible sequences and that it is therefore due to chance; 2) on the contrary, that life, precisely because it has not had sufficient time to prepare and therefore could not arise from practically zero probability, must be the result of a process that moved towards optimal stages as time and the number of 'trials' passed. The latter is the deterministic explanation: if life is an ordered state of matter, this order cannot arise out of nothing, it would be another way of asserting divine creation or rolling the dice of chance; instead, ordered structures within the original matter-energy in its chaotic manifestation and transformation are conceivable, whereby each organisational stage, even a primordial one, preserves the memory of the previous one, thus laying the foundations for the continuation of the dynamics towards successive stages. Randomised, i.e. random, forms of mutation must have existed alongside organised ones. The fact that genetics did not invalidate Darwin is that the organising element is selection, by whatever agent it is caused.

To a large part of today's scientists, such a solution seems a scientific heresy because it postulates a finalistic directionality in the entire mechanism of evolution, and would even be functional to the thesis of 'continuous creation' aimed at the superior product that would be man, dear for example to a theologian like Teilhard de Chardin. But the problem is to establish whether the number of combination possibilities bears any relation to the number of mutation possibilities; models based on information theory tell us that it does not, that matter has the possibility of autonomously assuming order and maintaining the information to do so again. The repetition of directed mutations means that there is an underlying law: a mutation can be attributed to chance, many mutations without order also, but many mutations that produce a statistic, hence an order, show us that the process is deterministic and not random. In fact, since Stanley Miller's (1953) experiments, every simulation of archaeozoic 'chaos' has not produced just any compounds but always the same twenty or so amino acids, the same purine and pyrimidine bases. The complexity of nature's structures in no way implies a consequent complexity of the underlying principles of its organisation. The laws of nature are simple and 'elegant' as Einstein said. Against the mystics and pseudo-materialists, nature is indifferent to the ideological barriers they raise, breaks them down and shows us the qualitatively superior result, inaccessible to them in principle.

So regularity exists. If it were possible to detect it, the law would be identified, it would therefore be possible to compress the spatial and temporal dimensions of nature (billions of years on the entire Earth) and reproduce life in the laboratory, to design truly artificial genetic structures by orienting the products of their 'translations' of symbols to desired and non-random functions. It will be possible for future humanity, not for today's humanity, it is busy serving Capital, consuming commodities no matter of what kind, provenance or toxicity.

Darwin and dialectical materialism

We do not know what algorithms were used by the biotech industries for the recent creation of the human genome map, but certainly no supercomputer programme could exhaust the calculation of all recombination possibilities, not even by working for centuries. In the process of computing, even if only to identify genes, the discarding of useless combinations must be contemplated, a bit like in chess simulation, where moves with no future are not taken into account by the computer. The principle is the one identified by Darwin and which he called natural selection. Undoubtedly there is an interaction between the environment and the genetic make-up of the mutating species, but if, as we have seen, mutagenic characters are inherent in the molecular structure, i.e. if there are precursor elements at all levels of evolution, the trick question is generally: how does matter that organises itself know in advance what its future may be?

This anthropomorphisation of problems must be combated. For Darwin's critics, natural selection understood as survival of the fittest is a mere tautology: survival of the survivor. The observation, albeit peppered with learned dissertations, is now almost universally recognised as nonsense. Survival of the fittest is not due to its peculiar qualities or to environmental selection or both: the organism in question became what it is in a determined process, during which it mutated while other organisms of the same species also changed, thus presenting a range of mutants destined for extinction. This materialistic hypothesis has recently been proven through the comparative study of human genes, a study that demonstrates two interesting facts: 1) the derivation of our current genes from two single progenitors, a male and a female who lived a few tens of thousands of years ago, all the rest having become extinct. 2) The difference in complexity and number of genes between the genomes of the various organisms does not correspond to the difference in organisation between the organisms themselves (the rice plant has twice as many genes as man). This means on the one hand that the selection of mutants is very strong and on the other hand that the quantitative datum does not affect the quality of the result, whereas the set of relationships that binds the organism's components, especially the proteins, and this with its environment operates in a qualitative sense.

What applies to individuals applies to the molecules of which they are genetically constituted and which are in a situation of perpetual non-equilibrium. DNA oversees the self-reproducing capacities of every living being, but if it were only able to reproduce itself, there would be no change, and therefore no evolution. Moreover, living beings within the same species are not all the same: the more dynamic the relationship with the environment, i.e. the further the situation is from equilibrium, the more important differences become in each individual's behaviour towards the environment, other individuals and the opposing species. Natural selection is not a fact to be photographed as it is, but follows a dynamic made up of relationships in which already existing differences interact with an environment that is itself changing precisely because of the presence of species that live, fight and die. Natural evolution is a highly self-referential fact, therefore by definition very close to chaos, from whose hidden structures new order arises at moments that some biologists call, lo and behold, phase jumps, our old discontinuous knowledge of any continuous revolutionary process. Natural selection is therefore not to be treated either as a tautology or as an immanent property of life, but rather as a set of relationships that we need to understand in order to know what consequences follow from given premises.

Natural selection is both cause and effect of the reproduction of individual and collective traits within species in limited spaces. Nature shows us that, in principle, selection operates indifferently both through the so-called struggle for existence and through the harmonious symbiosis of species; and the alternative is posed both by the genetic premises of the species and by the environment in which they not only live but which they help to create (a body is also an environment for the cells that make it up). In such a self-referential context, it is clear that the selection principle itself severely limits the value of possible combinations in molecular gene chains. In fact, nature does not leave the generation of a given sequence to the simple calculation of probabilities, but arranges it in a delimited sphere on the basis of relationships partly pre-existing in the given characters, partly due to the environment.

The existence of many species, from bacteria to sharks, from molluscs to rodents, that ‘have not evolved’ for millions of years would seem to prove a flaw in the principle of selection and mutation, but this is wrong: in fact every species that exists today is the result of selection and mutation. Today's bacteria are not the same as those that were progenitors of the earliest forms of life, but the product of an evolution that lasted at least a billion years and adapted to this world by specialising. Even today's bivalve molluscs look the same as they did in fossil times, but over the last five hundred million years they have transformed and the number of families into which they are divided has increased incessantly. This is also true for man: bushmen or aborigines are not remnants of ancient humanity, they are no more ‘primitive’ than we are, since they have had the same evolutionary time and have the same genetic heritage (i.e. they have undergone the same mutations, they are descended from the same stock), their history is as long as ours, they have merely reached a different technological level.

The mutant gene is ultimately not due to chance but to the history of the organism, just as the environment does not change at random but in the presence of a given life form. Every appearance of mutant is a product and at the same time a factor in a phase jump. This demonstration of Darwin's principle has been achieved both through the realisation of mathematical models and the preparation of specially treated bacterial cultures.

Now the twofold question is: regarding the phase jump, what is the difference between the appearance of a mutant in a natural historical context of millions of years and that in a brief laboratory context? And further: if man has gone through his own phase jumps in his evolutionary history, what phase jump awaits him now that he is able to produce mutants? Is he not already, himself, socially in the condition of a mutant?

We have tremendous things to say

For these questions, bourgeois conservation, even when it cloaks itself in the guise of ecological progressivism, cannot have answers. Its characteristic is apparent agitation but its ideological substance is motionless thinking. However, we know that the ideology of the declining ruling classes, although sclerotic and conservative, can do nothing against the emergence of material forces that represent the movement of transformation even of thought. Marx states that Darwin did not discover evolution - already known before him - but its laws, first and foremost that of 'genetic transformation due to hereditary accumulation'. An accumulation, he continues, of the same kind as that which man achieves by continually transforming what has been handed down to him from previous ages. This parallel between biological evolution and social evolution - including the phase jumps we have already seen - allows us to observe that capitalist accumulation is not merely the accumulation of capital but also the transformation of relations between producers. In short, there is a dialectical relationship between the dynamic that leads to the fixation of a genetic programme suitable for character conservation - let us say today - and the drive towards transformation induced by the further dynamic that is triggered when the programme is consolidated. Capitalist man in order to accumulate must transform, so he ends up learning to transform himself and his society according to a revolutionary programme.

If this is so, and for communists it can only be so, the big fuss about biotechnology, the manipulation of nature and disasters such as Aids, cancer proliferation and BSE must be seen in the light of far other parameters than those of indignation. And what do we care what the communists say, says the opinion-lover; but communists are not discoverers of hot water, nor of new horizons of thought (the latter task will be undertaken by our species in the future society); they are, like Darwin and like Marx, detectors of relationships, weavers using existing material. That is why we have tremendous things to say, as we have seen, demolishing barriers that prevent us from grasping the obvious.

Genetic manipulation is part of the evolution of man-industry and evolution is studied quite thoroughly by the bourgeoisie. On a level that does not touch on ideology, it knows how not to be reductionist, that is, it knows how to approach the problem from the point of view of the complexity of a world that has no caesurae between specialised departments but is a unity, exactly as physicists do, who consider the entire universe as a space-time continuum, made up not of matter and energy separated by a classification that is man's alone, but of the incessant metamorphosis of one into the other.

Serious evolutionists are also ecologists, since the whole evolves in relation to the way its parts evolve and vice versa. We call the biosphere a 'system' and apply cognitive procedures to know how it transforms over time, i.e. how it evolves: we can, for example, consider a transformation dynamic with respect to a) the number of species, including man; b) their variety and their relative frequency with respect to number; c) the biological mass represented by each species; d) the relationship between reproductivity and biomass; and so on. It is a quantitative criterion to deal with a qualitative problem, so there are objective difficulties of knowledge, but there is no other way but to make the quantitative criterion more complex. There is no way of deciding whether the parameters listed and enumerated correspond to what actually happens in nature, because the characteristic of the system, the most complex known to man, is to produce man himself, that is, that somewhat special organism that unlike the others is investigating the system and thus its own account. Evolutionary ecologists soon realised that progress cannot be made in this way, because the ordered sets that serve for description are always arbitrary: in the continuum of relations, it is not possible to formally describe discrete, separate sets.

But this is precisely what the barroom talker does when he talks about biotechnology and separates man from his work and the nature that produced it. Given a set of parameters E that describe the system at time t, it should be possible (in mechanical systems it always is) to identify a transformation law T that describes the transition

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$$E\ (t) \rightarrow E\ '(t+1), \text{ i.e.: } E\ '(t+1) = T\ (E\ (t))$$

Fear not, these are not 'difficult' formulae but another way of writing the title of this journal, n+1, applying its meaning to evolution and its phase jumps: we have one situation and then we have another following transformation (as when we schematise capitalist accumulation by writing D → D '). As always, one cannot set out to find a law, in this case the law of transformation, if one does not know precisely the parameters useful for describing the system. And since the system of relations from which we must derive the description is dynamic, its dialectic prohibits aprioristic hypotheses on both the law itself and the description, and therefore prevents the formulation of quantitative data. Any order of time, of space, of quantity relating to the 'pieces' of the system is vitiated by the anthropocentric 'ideological' interpretation. In fact, nature knows itself in another way, i.e. all at once, without scans of time, space, individuals or communities.

The impossibility - highlighted by the formula - of drawing an orderly, non-arbitrary representation of the system as the sum of its parts, forces us to change our view and treat it as a single whole, in space and time, where it is not permissible to differentiate between 'bad' and 'good' chemistry, monster-creating biotechnology and idyllic 'natural' biology, murderous industry and humanist industry. This system, like any living being, is an evolving organism, and will change when its dynamics lead it to the fateful phase jump, to mutate into a new species. It is only a question of knowing which, among the metabolic mechanisms of this organism, are the elements of normal turnover and those that molecular biology calls precursors of mutation.

All debates, involving only the mental programme of those taking part in them, i.e. their ideology, lead everywhere except down the road of material transformation, which for us is synonymous with communism: in these debates, it is possible to come to opposite conclusions from the same premises, a path that is highly dubious from a scientific point of view. Yet it is precisely scientists who lend themselves to this little game when they take the field by invading round tables. It happens with hypotheses about the universe, let alone with biotechnology, with depleted uranium, with BSE: in each case there is the expert for and the expert against certain perspectives. When you talk about it like you talk about... Coppi and Bartali, you will always find opposing sides irrespective of any rational decision criteria.

Blocking the search?

If we do not know by what mechanisms today's cells were produced with their genetic make-up, we cannot even know what effects genetically modified organisms will have on human nutrition and organisms in the environment. Only an empirical test could offer some data, but it may take decades of experimental verification. Therefore, when one claims the ‘precautionary principle’, stating that, in ignorance, it is better not to carry out biogenetic activity at all or limit it to the laboratory until knowledge is ‘safe’, one is simply claiming scientific censure. On the other hand, by adding distinctions, this vague principle becomes so differently interpretable as to make any agreement on shared objective grounds impossible. Research, yes, but controlled, it is said; in effect, this control ranges from prohibition, as was about to happen in Italy, to the extreme liberalisation as is the case in England and the United States, with so much respect for firm principles.

However, the researcher-type, feeling himself a participant (more or less in good faith, it does not matter) in what is commonly defined as the adventure of human science towards progress, has the answer ready: the characteristics of humanity include the tendency to risk; in today's world, blocking research into biotechnology is like being against science; it is as if at the dawn of industry, the formulas of mechanics, experiments with steam engines and prototypes of automatic looms had been banned; since no one knew whether modern industry would be possible without causing deaths, injuries and environmental disasters, would it have been better not to dare to carry out tests and experiments?

And within the current reference system, which is the same for everyone, scientists and mystics alike, our researcher is right, of course. Everyone knows that industry has caused millions of deaths and that one of its products alone, the car, is responsible for 250,000 deaths a year worldwide. But no one, not even in the face of proven proof of the dangerousness of the industry and its goods, thinks of sit-ins and demonstrations in front of Ford or Toyota for this. On the contrary, in Seattle they were also demonstrating to defend the possibility of making cars not only for Western and Japanese consumers, but also for the entire world population that is still deprived of this mainstay of modern capitalism.

Similarly, the many causes of illness and death produced specifically by this society do not provoke any particular reaction. People just die resignedly. Yet it is even trivial to observe that the much-vaunted technology itself could already contribute to improving the condition of the species. Instead, falling ill, getting on a plane, sitting down to eat, means, from the point of view of survival, entering the world of mere probabilistic calculation, because no capitalist activity is aimed at man. Whose life is so caught up in the anarchoid machinery that at every disaster he finds a remedy that causes an even worse disaster, because further remedies within the parameters of the current mode of production no longer exist, especially in the fields of health, food and the environment, those most affected by biotechnology.

Let us take wine production. There is no doubt that the industrialisation of vineyards has led to high production per unit area and high quality compared to small-scale parcel production; but also to a high susceptibility of vines to pests. Therefore, the industry had to provide methods and products to remedy the situation. After a few years, the plants can no longer cope with the mechanical-chemical cycle and no longer yield or even die. The uprooting of a diseased vineyard and its reconstitution involves a heavy 'reclamation' of the soil, costly in terms of machinery and labour, new chemicals and above all time. Now genetic engineering is able to modify vines so that they become more resistant to pests. Is this or is this not a good thing from an economic point of view and also from a health point of view, since there would be fewer treatments with traditional poisons and the race between the potency of these and the resistance acquired by pests would cease? This is where the debate between proponents and detractors of biotechnology comes in, while governmental and alternative committees produce results close to zero. In fact, the chemical cycle cannot continue indefinitely, the natural cycle is lost forever (unless someone explains how to return to the ecological situation before the peronospera and various diseases) and biotechnology solves the problem in the short term, but no one knows whether or not it triggers a new hellish cycle of pest-busting, as is already happening in the cereals field. The only solution would be to put an end to the cycle, but neither laboratories nor debates nor committees will succeed in doing so.

Eugenics, no man's land

Another example of the fact that it is materially impossible to solve such important social problems in the capitalist sphere is eugenics. It is said that biotechnological research serves to improve the health of mankind, which would also benefit genetically in the long term. As long as capitalism exists, this cannot be true. The improvement of the human species and its living conditions through the fight against diseases - genetic and otherwise - would be possible, if only from the establishment of non-pathological conditions, but certainly this branch of knowledge has had aberrant interpretations with capitalism, having been practically monopolised by more or less racist currents.

Buried for the reasons mentioned above, positive eugenics, survives the so-called negative eugenics in the field of premarital checks and pregnancies; but these are specific medical practices with no relation to a species vision. Instead, there is a 'spontaneous' eugenics of enormous scope that threatens to undermine the vital characteristics of the human species by intervening directly in the genetic heritage even without so much biotechnology. Through the massive, premeditated, industrial use of reductionist medicine, tailor-made for a catalogue of diseases suited to a catalogue of corresponding pharmacological commodities, the human species is weakened as such, introduced into a production cycle such as that of viticulture, which we have described, where addiction to the drug causes the need for ever more massive doses and where the vine strain degenerates to the point of necessarily requiring a higher-level intervention, the transition from chemistry to biotechnology.

Just as chemistry is not 'guilty' of the use to which it is put (photosynthesis, which allows the life of the plants we eat and produces the air we breathe, is also chemical), so it is stupid to criminalise biotechnology per se, especially by loading it with properties it does not possess.

Living beings in their natural state rarely experience disease, as Darwinian selection acts at the macroscopic level with the survival of the fittest (or rather the elimination of the less fit). Humans and domestic animals, even if they live longer, are more susceptible to disease not only because they are deprived of their natural environment, but also - and this fact is no less important - because medicine objectively acts contrary to Darwinian selection, which would be achieved by the elimination of the diseased. For example, allergies are on the increase in the most industrialised countries, so much so that the large pharmaceutical multinationals have identified a specific market for over-the-counter drugs. Entirely determined by the industrial urban environment, humanity is developing new genetic sensitivities to combined chemical agents specifically produced by capitalist civilisation. The treatment tends to alleviate the symptoms without, however, eliminating the causes, which are external to the organism, so the organism is enabled to live longer with its ailments, but also to transmit its sensitivity, until biotechnological intervention becomes necessary.

Experts in evolutionary ecology emphasise that the lengthening of life is a genetic fact, i.e. not so much due to medicine as to improved living conditions, like the increase in stature and body weight (the stature of American boys has grown by an average of 20 centimetres in sixty years). Thus, life span is lengthening, but senescence is still the same, and as the diseases of 'civilisation' have increased, the condition of the elderly person is increasingly that of the drug addict. That is why, having eradicated the infectious diseases that once decimated children, the pathology of old age becomes a gigantic business for industry. Civilisation blocks natural selection and the human species accumulates in its genetic programme new sensitivities, new diseases, new breeding grounds for patented drugs.

Enormous urbanisation and incessant industrialisation, hence the increase in stress and pathogens, have led to the multiplication of previously rare or even unknown disease states. Since it is not possible to prevent the causes of the new social pathological situation upstream, everything is resolved in the search for new treatments, which, in turn, interact with the existing situation, reinforcing the trend towards new pathological stages. It becomes entirely logical, at this point, to include biotechnology in an automatic process of replacing chemical pharmacology: just as certain plant species have been made resistant to specific herbicides, so humans will be made capitalistically resistant to agents that cause allergies, carcinogens, etc. Thus, just as maize will resist massive doses of herbicide, so will humans be able to resist massive doses of all the filthy crap that capitalism cannot help but foist upon them.

The possibility of damage to the species over time, as we can see, is enormously greater than that which genetically modified organisms can produce for the direct food cycle. The bio-researcher is right when he states that inhibiting the gene encoding for the protein molecule responsible for the 'mad cow' disease would prevent humans from falling ill with that disease, but he is silent on the fact that this would save the whole monstrous mechanism that made it epidemic among mammals with the relative leap between species and species, and we would continue to draw food from a perverse chain. He is right that new transplant tissues obtained by manipulating the appropriate molecular chains into stem cells can save lives; but it is the context of the consequences for the species that is missing in his reasoning.

Hitler in this field was an amateur compared to what could be done today. In Mein Kampf, the improvement of the Aryan race is entrusted to a piloted selection for 600 years, with reasoning based on the methods humans use in animal breeding. Hitler's attitude was 'bestial' only because it took place within a capitalism that had not yet come to deal with the subject in a scientific manner. Today, no one speaks of eugenics, but without even having the goal of improving the species and without yet having officially initiated human genetic bioengineering, even at the level of test tubes, frozen seeds, surrogate wombs, hormonal stimulation and therapeutic fetuses, manipulations on life are already being carried out that are far more fanciful than Hitler's.

Beyond simplistic appeals, if humanity wants to eradicate what is now called disease, it will certainly have to deal with eugenics, organically, not animalistic or scientistic. For the Greeks, man was only an ugly approximation of the ideal and perfect form, which is why they kept man as he was and applied intelligence in an attempt to transfuse perfection into marble. Future man will abandon perfection as an idea and apply the harmony of form to himself instead of to statues. He will relate directly to the powers of nature without the need for the intermediaries of Olympus. But he will not do so according to the schemes of present-day medicine, whether traditional or biotechnological, bent on making a profit and indifferent to perpetuating the disease, from which, if it succeeds, it will only heal the individual paying customer and not the species it does not care about at all. After all, the biotechnologist who deals with disease in capitalist society, like all doctors, cannot be consistent with his oath: if he were completely successful with his work he would be unemployed and his profession would also be wiped out.

Sorcerer's apprentices

It is said that on the eve of the detonation of the first thermonuclear bomb, some scientist was not too sure that his equations guaranteed the reaction only in the uranium and not in the surrounding matter, that of the entire world. Today we read about super particle accelerators that other equations would not guarantee the formation of a small black hole capable of absorbing all the matter on the planet. These are news stories, but they are significant with respect to the uncertainties and fears surrounding the frontier territories of human knowledge.

In a world so random as to produce the feeling that survival depends on the calculation of probabilities, biotechnology cannot fail to produce a sense of insecurity and immediate fear. Life belongs to nature, it is said, and man observes it, studies it, reproduces it in manipulated forms. The separation of man-industry from nature is arbitrary, but this does not enter the head of today's man so easily. The situation is made worse by the fact that we know about life processes, we know how to reproduce them from living matter, but we know almost nothing about the historical process that produced life and ourselves as its social outcome. Thus, when man sets about production in this field, in the laboratory-industry we lose sight of the fact that this social transformation due to science is just as inevitable as genetic mutations within species or the so-called industrial and scientific revolution.

Everything we know about the origin of life is derived from what we know about chemistry and physics. However, with regard to genetic phenomena, our knowledge in the other fields serves us to describe particularities that are specific to the living and do not exist elsewhere. If the living is ordered matter, as indeed it is, this order is of little help to us in understanding its origin, because once realised it seems to spring only from itself to reproduce. We know that metabolism, growth, reproduction, selection, all require a dynamic, unstable situation, so that every now and then there are phase jumps in which changes at the atomic level end up manifesting themselves at the macroscopic level, resulting in very evident forms. The entire causal chain, apart from the origin and 'spontaneous' mutation, is determined, hence known, so much so that it is possible to reproduce it in the laboratory and predict the results. We have tried, together with the reader, to tread the paths already known and look into the unknown ones, and we have seen that life cannot yet be created, but it can be manipulated with a great variety of results, some of which are curbed for ethical reasons that are often pretextual, stemming from an irrational vision, and others, perhaps more risky, encouraged and financed.

As the worst product of biotechnology, bioethics was born, more monstrous than any cloning and any biomonster spawned by science fiction. Asking whether it is ethical to genetically transplant different organisms by expanding nature's wealth of information makes as much sense as asking whether it is ethical for nature itself to proceed by evolutionary stages of the living or for a farmer to hybridise his livestock. Asking whether it is permissible to manipulate living organisms and introduce them into the environment is like asking whether it is permissible to continuously adapt the influenza virus, which has mutated more in a few decades than a mammal's gene has mutated in millions of years. Is it licit for man to do what his nature has led him to do, to use antibiotics, pesticides, cars, plastic, herbicides, and even medicines that block natural selection by not letting people die?

Man-industry-nature cannot not change the planet and it is only by doing so that he learns to do it well. Perhaps he will return to wooden houses, linen or cotton clothes and perhaps horses, that is, to a less stressful life where space and time are no longer tied to the concept of exchange value; but he will never return to non-science, to human prehistory without technology, without industry and without project activity; he will not return to the inability to control his own existence. Now, even if he could already, he does not yet know how to do so, especially in harmony with the nature of which he is a part, but current industry, technology and science are the necessary means for him to reach that height.

The more the social productive power of the human species increases, the more its capacity to do harm by any means increases, even by those that today might seem the least devastating. And so man needs to develop even more knowledge - not less - about the phenomena he has set in motion. It is utterly absurd to want to get to the bottom of the serious problems posed by biotechnology by disregarding the real world, with its social system, with its six billion inhabitants growing at the rate of a hundred million a year, with its absurd misery due to paradoxical overproduction.

It is true: today's science puts means in the hands of scientists and industry that are too powerful for the control they can have. And it is also true that the still thinking of the bourgeoisie has not produced an adequate ethic, not even a bourgeois one. However the revolution presses on, and even bourgeois science, against the ideology of the class that expressed it, is able to show that it is not a question of ethics: if we seek to derive knowledge from the physical world and its laws, not therefore from our individual brains but by means of them and with the help of the knowledge gained from many other brains, then we no longer need either ethics or philosophy. Since philosophy as such is no longer necessary, the need for any ideological system also falls.

The whole of natural processes is a systematic concatenation of relations and forces science to search for them everywhere, in the particular, in the general, in the physical world, in the biological world, in the social world, without making undue separations except, when useful, for descriptive convenience. Precisely for this reason, there is no need for a silly specific ethics, there is a need for the revolution to continue its course until the next phase leap.

Recommended readings

- Manfred Eigen, Steps to Life - Prebiotic evolution in the light of molecular biology, Adelphi Edizioni.
- Manfred Eigen, Perspectives on Science, Laterza.
- Jacques Monod, Il caso e la necessità, Mondadori.
- International Communist Party, 'Comment Monsieur Monod terrasse la dialectique', Programme Communiste no. 58, 1973.
- François Jacob, The Logic of Living, Einaudi.
- Karl Marx, Economic-Philosophical Manuscripts of 1844, Complete Works vol. III, Editori Riuniti (chap. 'Private Property and Communism').
- On the Directory page of our site, under the Science & Technology button, you will find several addresses of specific sites on biotechnology, human cloning, 'mad cow', etc. (www.ica-net.it/quinterna/topics_directory/science.htm).

'A botanist, a good connoisseur of the plants of his region, wrote to inform me that in that year the seeds of the common bean had grown everywhere on the side of the pod opposite to the normal one. I wrote back asking for more news because I did not quite understand what he meant; but for a long time I had no reply. I then read two short articles in two different newspapers, one published in Kent, the other in Yorkshire, in which it was stated as a most interesting fact that 'in that year all the beans had grown on the opposite side of the pod. Such a general statement must have had some foundation, and I therefore wanted to ask my gardener if he had ever heard anything similar. He replied: 'Oh no, sir, that must be a mistake, because beans only grow on the opposite side in leap years, and this one is not'. I asked him how beans are placed in normal years and how they are placed in leap years, but I soon understood that he knew nothing about the growth of bean seeds in any period; and yet he remained firm in his conviction. After some time I received a letter from my first informant who, with much apology, told me that he had only written me the first letter because he had gathered the information directly from several intelligent growers; but then, talking to each of them, he realised that in the end no one could clearly explain what he had meant. Here, then, is the case of a conviction which has spread through almost the whole of England without the shadow of a proof, if one can call a conviction an opinion which is not based on a very clear idea'. (Charles Darwin, Autobiography)