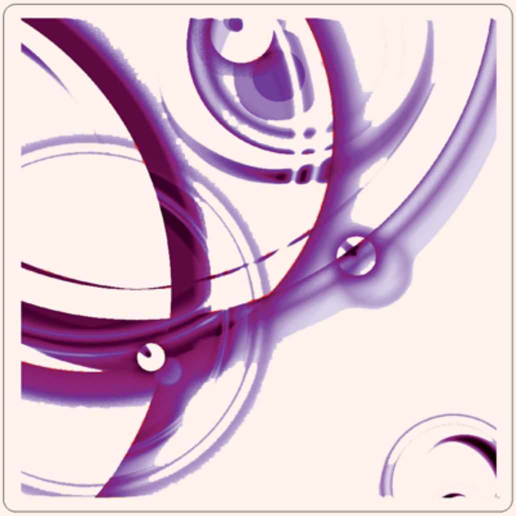

A Biology for Development

François Gros

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SUMMARY

SECOND PART
BIOLOGY AND THE GREAT DEVELOPMENTAL CHALLENGES

PREFACE

The rhythm of scientific progress varies. Times of stagnation or even setback are followed by stages of rapid improvement when old obstacles seem to disappear as if by magic, suddenly laying bare to the researcher's curiosity a whole new area of feverish conquest. But these periods of keen exploration are marked by a certain confusion: attention is dispersed in different directions, the accumulation of results seems incoherent, discordant explanations of the same facts multiply, and predictions increasingly diverge. Thus, they are also periods when regular assessments must be made to take stock of the progress accomplished. The scientific community feels a particular need to understand how it was led to the present situation, to accurately register all genuinely new possibilities, to establish an inventory of the products of its multiple investigations, to assess their potential in terms of applications, and to measure the full extent of the remaining difficulties to be overcome in conquering the emerging world of knowledge. This task is by no means secondary to the process of scientific discovery. Quite the contrary, it is an essential one serving to clarify and guide this process, fostering its momentum by providing it with firmer foundations. Mapping a discipline in the process of transformation is still taking part in its transformation.

Biology, broadly understood as all the disciplines that take living organisms as their object of inquiry, is undoubtedly one of the main scientific fields to have entered such a phase of acceleration since the middle of the last century, as illustrated in particular by the revolution of molecular biology, which penetrated the deepest foundations of life by elucidating some of the most elementary operating principles and structures of the cell. That the unique impetus then given to biology has retained all of its strength today, is undeniably confirmed by the constant results flowing from laboratories, results sufficiently important to be echoed almost daily in the general press, provoking a mixture of admiration and dread in society confronted with the new prospects thus open to humanity. A single, but particularly striking, example demonstrates this vitality. To improve understanding of embryonic stem cells, researchers in Great Britain recently received authorisation to produce embryos of indeterminate status, since these embryos are obtained by the insertion of an adult somatic cell nucleus into an animal oocyte, thus carrying a human genetic inheritance without however qualifying as human ones. By making it possible to overturn one of the most fundamental divisions of the ordering of organisms elaborated by evolution, the scientific exploration of life cannot offer better proof that it has well and truly crossed the frontier of a new territory, the limits of which remain impossible to determine today.

If biology is consequently also one of these scientific fields where the need to take stock of its progress is most pressing, clearly no-one is in a better position to perform this arduous task than biologists themselves, at least those who can fully appreciate the extent of the transformations affecting their discipline as well as master its main theoretical foundations.

Such is precisely the task that a renowned geneticist addresses in this book, even as he emphasizes the benefits that this blossoming of biological knowledge might bring for the resolution of the challenges raised by the development of contemporary society, and also the perspective offered by genetics which is his field of expertise. Few people are indeed better qualified for this undertaking. Not only was François Gros a key player in the molecular biology revolution, through his work on messenger RNAs in particular. He is also one of its most accomplished analysts and historians. From *Secrets du gène* (1969) to his *Mémoires scientifiques* (2003), via *La Civilisation du gène* (1989) and *Regards sur la biologie contemporaine* (1983), he has repeatedly strived to bring to light the theoretical significance as well as the societal implications of this dramatic transformation in biological knowledge, in which he was both an actor and a privileged witness at the side of Jacques Monod and François Jacob. Nearly thirty years after the report he wrote with Jacob and Pierre Royer for the French President about "the consequences that the discoveries of modern biology might have on the organization and functioning of society" (*Sciences de la vie et société*, 1989), he offers in this new book his latest analyses on how the most recent advances of biological investigation may, and within what limits, lead to significant progress in the domains of health protection, food production and energy supply, three essential areas of social development. Furthermore, by first recalling the main episodes of the scientific adventure which led to these advances, he sheds light on the relation between the trials and errors of basic research and the applications that they ultimately make possible, the way in which basic research fosters potentialities that applications only gradually delineate, at times so unpredictably that the original discoveries from which they derive appear even more fabulous.

François Gros' reflections are not only of interest with regard to the actual state of biological knowledge today, but naturally also to the issue of development and the means of resolving it. From this point of view, their significance is even greater when we read them in the light of the new relationships being built between science and development.

Indeed, these relationships have changed. Society no longer asks science simply to help it develop, but also to help it develop differently. Society no longer expects from science only more development, but also another type of development, thus granting to scientific knowledge a more essential role than ever in the quest for a better future, and increasing in similar proportions the responsibility of scientists. To fully appreciate the extent of this new responsability requires one to briefly examine the close relationship that has always united development to science, and the unprecedented crisis in which this relationship unquestionably foundered over the last quarter of the 20th century.

But it should first be asked what people exactly mean when talking of the development of societies. Although it is now recognised as the subject of a specific discipline known as development theory, with its own research centres and training courses, as well as a myriad of national and international institutions with a more practical aim, this notion is still seldom defined. Even if it clearly refers in all its uses to a process of transformation, it is not unequivocal, and when applied to societies, its meaning is rather specific. It would be particularly inappropriate to take it as synonymous for growth in such a context. For even if an increasing population is admittedly a population which in a certain sense of the word is developing, this growth is often a factor of under-development. Similarly, a transport system perfectly identical to another one in terms of geographical points connected, number of vehicles in circulation and amount of people transported, but much more advantageous in terms of energy consumption and toxic emissions, would clearly be considered by development theory as more developed than the other one. The concept on which this theory is based is therefore also, and even primarily, qualitative. It seems reasonable to suggest that, at its most general level, this concept refers to the process by which a society improves its global capacity to satisfy the needs and desires of its population. And, consequently, that a difference in degree of development corresponds to a difference in state of such a capacity.

This definition is particularly recommended for its aptitude, through the idea of global capacity, to explain the fact that a society considered as having reached a certain degree of development may, in reality, display major differences in its capacity to meet each one of the different needs of its population, for example between those of health and those of transport. It also gives the notion of development a welcome relativistic flavour without lapsing into relativism. For, if the degree of superiority of a capacity to satisfy certain needs with respect to another can largely be determined by objective criteria, what is considered as developed at one stage is nevertheless destined to look underdeveloped at another, unless any improvement is impossible. Moreover, it leaves entirely open the possibility that some ancestral technique, for example in agriculture, should be estimated better than a modern technique when ecological impact criteria are taken into account, and therefore that the ancestral one represents a higher degree of development. Finally, this way of looking at development seems to fit its human specificity. Indeed, it is patent that animal societies, in the sense of development theory, do not develop. Only human societies do, because animal societies are deprived of the ability to truly improve their capacity to satisfy their needs and desires. Ever since they came into existence, gazelles have found no better way of avoiding ending up in the lion's digestive system than trying to run faster than him. At best, an animal moves from one territory to another to make the most of the capacity to meet its own needs with which it is naturally endowed, but it cannot improve this capacity itself, and transform its condition as a result. The human societies that we call primitive can be considered as societies engaged in a particularly slow process of such improvement, or in a process of improvement different from the one that has become predominant in the world through Western Europe.

It seems undeniable that certain types of political, legal and economic organisation within a given society, or in its external relations, can contribute directly to development so understood. However, it is no less true that these organisational factors have above all a crucial role to play with regards to guaranteeing fair access to the improvement process that defines development. This improvement process itself is rather a matter of advancement of knowledge, not of the kind of metaphysical speculation or religious revelation, but of the kind we call scientific and technical, the latter generally being based on the former. It is in fact this decisive contribution to improving the capacity of societies to satisfy their needs which has ensured the success of the scientific enterprise since the 17th century Scientific Revolution; and it does not seem an exaggeration to say that it has been gradually converted entirely to its service.

Although it always had critics, the trust thus placed in the power of science to help societies make progress towards satisfying their needs and desires was shaken in a particularly deep way in the last three decades of the second millennium. This disruption originates in the realisation that the progress made has, in fact, been accompanied by serious negative effects, such awareness being itself largely the consequence of the increasing amplitude of these effects that came along with the acceleration of progress. In other words, development reached crisis point at the same time as it reached its peak, precisely because its drawbacks themselves reached an extreme state. This is why this crisis, in a way the price of success, has been concomitant with the unprecedented industrial transformation of the period following the Second World War, marked both by the rebuilding of Europe and the progressive industrialisation of Third World countries, thanks to the decolonisation process.

It finds a very clear expression at the level of international institutions, and of the United Nations Organisation in particular, even if the attitude of these institutions owes a great deal to the critical work of a number of pioneering individuals and associations. It is for instance under the influence of the warnings launched in 1970 by the members of the Club of Rome in their famous report *Halt on growth*, that the UN formulated its first major concerns and recommendations during a conference on the environment organised in 1972 in Stockholm, where it was solemnly declared that “a point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences”, and that “through ignorance or indifference we can do massive and irreversible harm to the earthly environment on which our life and well being depend.” The first consequence of this declaration was the creation of the influential *United Nations Environment Program* (UNEP*)*, then the establishment of the *World Commission on Environment and Development* which conducted a survey from 1983 to 1987 on the state of development on the planet. Headed by Gro Brundlandt, a former Prime Minister of Norway, this commission provided in particular an explicit definition of an alternative development route which the UN invited all countries in the world to follow, and paved the way for the most symbolic of these large international meetings which gradually called into question the opposite path followed until then: the 1992 Earth Summit of Rio de Janeiro, which, among a number of important resolutions, approved the famous programme of measures known as Agenda 21. The *United Nations Commission on Sustainable Development* (UNCSD) was created at the same time to monitor the implementation of this Agenda; and in 2002 the latest UN general summit on development was organised, the *World Summit on Sustainable Development* of Johannesburg, to assess the progress made and give new impetus to the commitment of nations.

It is important to highlight the singularity of the criticism of development, and of the scientific progress underpinning it, which drives this whole movement. Indeed, a full tradition of political, sociological and philosophical thinking had already thrown suspicion on them a long time ago. But the motivation of this tradition was, above all, to denounce inequality in the distribution of benefits which development and scientific progress had provided and could provide, as well as the pillaging of the resources and labour of a portion of humanity on which they were seen to rely. Or also, at a later stage, to denounce the cultural impoverishment that they brought through the establishment of a consumer society centred on the search for purely material well-being. The criticism which took shape in the early 1970s in the international movement described in the previous paragraph is much more radical, since it questions the very ability of development and scientific progress to ensure material well-being, in the name of the new threats they engender, and which are considered as powerful as the ills they are supposed to overcome. Hence the decisive importance played in the emergence of this criticism by the question of environmental damage, that provided the earliest and most explicit manifestations of these ills. An importance well reflected in the chronology of the UN response to the crisis. The Stockholm conference which marked its starting point was indeed a conference on the environment, and resulted in a declaration about the environment. It was only in a second phase that the Brundtland commission emphasized that environmental issues could not be separated from those of equal distribution of the fruits of progress, basing their argument on the premise that progress, in order to avoid being self-destructive, must not destroy the environmental capital from which it draws its source, and should also be able to distribute dividends to the entire human population. The role played by climate change is equally meaningful in this respect. Through their global and no longer local dimension, the increasing manifestations of climate change over the last few years clearly marks the peak of this entire crisis, as well as at the moment when it grips the imagination on a global scale and ceases to be the sole affair of committed ecological groups, thus demonstrating unequivocally how much its source lies in the damaging effects of development on the environment. What good is it to have factories supplying us with any number of consumer goods or with vehicles which can take us anywhere we wish, if the price to pay for them is a climatic disturbance which dries or floods the land on which we live and which feeds us, making us vulnerable to apocalyptic physical threats and famines man has fought to overcome over the centuries?

By questioning the ability of development and scientific progress to improve our material well-being, this criticism is also more radical in that it questions their reality itself. Not by denying their undeniable successes, but by invoking the ills which these successes have engendered, counterbalancing them to the extent of destroying them at times. The basic idea behind such criticism is therefore that the process of development undertaken by humanity so far, having “reached a certain point in its history”, has started to cancel itself out. That its apparently eternal victories are actually only temporary, either because they have simply eliminated one evil only to generate another, or because what they seemed to have vanquished is rising again from its ashes, like these biblical floods or food shortages which once again are thought to threaten the 21st century.

And this is also why the fundamental claim to which it gave rise is that of sustainable development. What is indeed a sustainable development, if not a development which is perennial because it does not cancel itself out in time? It would be a mistake, however, to see this notion as a radical innovation. Apart from a few excesses, development has always been essentially intended to be sustainable and to produce permanent benefits. The problem is rather that it has proved not to be so, and that we can no longer delay replacing it with one that really is. The form of development followed until now can only be qualified as non-sustainable in the sense that it was under the illusion of being sustainable, and not in the sense that it was deprived of the intention of being so. Undeniably it can be criticised for falling under this illusion partly at least through heedlessness, and therefore owing its failure to thoughtless attitudes. This is why also sustainable development can only be conceived as a form development truly guided by a new intention if it is understood as one animated by a much deeper concern for its sustainability. The demand for sustainable development is not a demand for a development with no risk of cancelling itself out, but for a development which takes every possible precaution to minimise this risk. It is in this only that it constitutes a new mode of development, whose novelty is nothing else than a much more vigilant awareness of its responsibilities.

But how can this be achieved? The temptation is always great, when faced with a sizeable failure, to challenge that which led to it. This is a perfectly rational attitude, unless it lapses into excess. Can we relinquish scientific knowledge and break its secular link with development? Our society is clearly incapable of it, apart from the question of whether a society can in principle develop without science. This is no longer a real possibility for ours, even if it were one in principle. What the Stockholm declaration probably does not emphasise enough is that the point we have reached in history is also, in this respect, a point of no return, and that we are condemned to maintain the alliance of development and science. First of all, because science alone can adequately diagnose the damage already done, as shown by the numerous expertise agencies nowadays needed to provide guidance about the purity of our water, the harmlessness of our food and the innocuousness of our air, and of which the *Intergovernmental Panel on Climate Change* is perceived as the heroic figure. Secondly, because science is essential for repairing much of this damage, even if it cannot do it all. Finally, because science alone can supply most of the instruments necessary for the survival of the humanity born out of our past, unless we accept to plunge it into an unprecedented regression, of precisely the sort which the club of Rome was predicting under the name of collapse. The development crisis condemns science much less than it condemns us to science. Science must continue its construction, renew its efforts and go beyond its present limits, in order to repair past mistakes it made possible as well as to open safer horizons. Something which cannot be achieved without crossing new frontiers. Society expects for instance science to reduce the excessive concentrations of atmospheric carbon dioxide resulting from the exploitation of fossil fuels, to replace these with a cleaner and yet as efficient energy, and finally to move forward in the direction of energetic abundance. A threefold expectation which cannot be fulfilled without penetrating natural mechanisms of which we know very little at the present time. The challenge of sustainable development is essentially a challenge of scientific and technical innovation, because it requires from us that we can do things currently beyond our capacities, and to which only research can give us access.

This primary role of scientific knowledge in the conquest of sustainable development is widely acknowledged and has been reasserted with growing force, for over almost forty years now, at each one of the crucial stages of the mobilization in favour of sustainability. As early as 1972, principle 18 of the Stockholm declaration states that "science and technology... must be applied to the identification, avoidance and control of environmental risks and the solution of environmental problems and for the common good of mankind." And the Rio earth summit declares in chapter 35 of Agenda 21 that "scientists have a growing understanding of such issues as climate change, increases in resource consumption, population trends and environmental degradation... [which] should be used to shape long-term strategies for sustainable development", and officially recognises the scientific and technical community as one of the nine social groups essential to the reorientation of our mode of development. As a result, this community was closely associated to the preparation and realization of the Johannesburg summit through the *International Council for Science* (ICSU) and the *World Federation of Engineering Organizations* (WFEO). Finally, the Nobel Prize awarded to the IPCC in 2007 obeys to the same line of thought, and at the same time brings it to culmination. But it is perhaps in the presidential speech given by biologist Jane Lubchenco at the annual congress of the *American Association for the Advancement of Science* of 1999 that this recognition of the primary role of scientific knowledge found its most vibrating expression. Acknowledging explicitly that "fundamental research is more relevant and needed than ever before", she called for the entire scientific and technological community, on the threshold of the third millennium, to sign a "new contract" with society, in which it agreed to "harness the full power of science of the scientific enterprise... in helping society move towards a more sustainable biosphere".

This way of using science to serve the pursuit of a mode of development concerned about its sustainability is not without implications on the way scientific investigation should be conducted, and of which ICSU, in line with its participation at the Johannesburg Summit, has offered interesting analyses, particularly in its report on *Harnessing Science, Technology and Innovation* *for Sustainable Development*. This new approach to science calls in particular for the establishment of new forms of interaction between the scientific community and other components of society at different stages of the scientific process, in order to coordinate the choice of research objectives with the actual needs of populations, to allow the results to be more easily available to those who can exploit their industrial potential and those in charge of legislation and government, to foster better understanding of their applications by public opinion, and to discuss the ethical and legal issues as constructively as possible. The transformation of science required by sustainable development is not only a matter of discoveries, it is also a matter of ways of investigating.

And it is in this twofold perspective that *A biology for Development* should be read. Although François Gros' main purpose is to clarify what the major results of contemporary biology, generated by its molecular revolution, are starting to bring to the quest for of a form of development at long last in control of its consequences, his commitment to greater interaction between the world of science and the rest of society in the process of research is unambiguous. Not only does he support the work of the ICSU, to which he refers, but throughout his career, especially through his responsibilities as head of the Pasteur Institute and the French Academy of Sciences, he has multiplied such initiatives. His decisive involvement in Biovision, the World Life Sciences Forum, is perhaps one of the clearest illustrations of this commitment. Organised by the Scientific Foundation of Lyon, the Forum is precisely a decade long effort to contribute to a more efficient articulation of the life sciences with the main developmental challenges of contemporary societies, by inviting researchers, industry representatives, political decision-makers and opinion leaders to debate the most recent orientations of biological research in the light of pressing developmental issues. François Gros' book undoubtedly draws some of its inspiration from his involvement in this unique and daring enterprise. All those who designed, founded and animated it will surely find it to be a powerful stimulus for perseverance. And they thank him for this.

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