

INSTITUT DE LA VIE

**SCIENCE IN THE
SERVICE OF LIFE
GLOBAL PROBLEMS**

INSTITUT DE LA VIE

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INTRODUCTION

(translation)

A quarter of century ago, in 1960, a few men rose up at our appeal to lay the foundation of « the Institut de la Vie ». During their long march the cohort has grown until now it includes 2 500 men and women scientists, from 60 different countries, including 50 Nobel Prize Winners. The Institut de la Vie hopes to provide a voice for the conscience of science and the will of mankind to live.

On February 12, 1986, letters expressed in the same terms were delivered to the Ambassadors to France of the United States and the Soviet Union. The letters proposed a challenge and a theme. A challenge : Yes to life. A theme of international cooperation : Science in the Service of Life : Global Problems. The Institut de la Vie wanted to seize this rare moment in which the Heads of State of the two very great powers are exchanging their views on the world situation.

The two long and very impressive replies from Secretary General Gorbatchev on March 7, 1986 and from President Reagan on April 29, 1986 are of extreme importance. They give to life its political nobility. They give to science its place in the great affairs of the world. They are expressed in a language of values and responsibility. They demonstrate a willingness to work in a spirit of bilateral and world-wide cooperation.

And thus the Institut de la Vie finds itself entrusted with a unique mission : to build up proposals on which a universal consensus may be established.

From October 13 to 17, 1986 and from January 5 to 9, 1987, scientists from eleven countries came together in Switzerland at the invitation of the Institut de la Vie. These men have formed themselves into a permanent committee which will be joined by scientists from at least twelve other countries. The purpose of the conferences was to

prepare a first program on the theme : « Science in the Service of Life : Global Problems ». The Heads of State or of Government of eight countries have honoured the Institut de la Vie and shown their interest by generous messages conveying good wishes.

At the end of these meetings, the attached resolutions were approved unanimously. They were written with the will to be useful to all the peoples in the world.

The Institut de la Vie does not presume to substitute itself for the great national and international scientific organizations nor for the government or inter-governmental organizations or agencies. It calls for a trusting and fruitful cooperation.

The activities of the Institut de la Vie are carried on with scientific rigor and objectivity. Operating on an inter-disciplinary basis, they are inspired by a global vision. They have no political character. The Institut de la Vie refuses to interfere in the internal affairs of countries. Its philosophy is positive, aware of essential values, conscious of ethical issues, deeply concerned with life, in the service of the whole man and of all men.

Because of its acquired experience

- its scientific representativeness
- its moral and diplomatic credit
- the strength of its structures
- its doctrinal security
- the rigor of its method

it seems that the Institut de la Vie is designated by its own history to continue to inspire the healthy development of the concept of life.

Life is bursting forth in the great international debates and will provoke a historical change in orientation of the policy of the nations : the challenge of life will dominate human history for centuries to come.

Maurice MAROIS

SCIENCE IN THE SERVICE OF LIFE GLOBAL PROBLEMS

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PREAMBLE : SCIENCE AND HUMANITY

Life on this planet, especially the life and wellbeing of all mankind, is in peril. Thoughtful people all over the world, including the majority of scientists, recognize this danger. The Institut de la Vie seeks to bring the powers of science to bear on these problems with the conviction that rational human minds will triumph and that life, in all its magnificent diversity, will survive and develop to new heights of achievement, in spite of global pollution of the environment, the reduction of biological and genetic diversity, and the degradation of protective features such as atmospheric ozone. To provide another example, acid rain creates injury far beyond the sources of origin. Thus mankind is entering an epoch in which it is becoming necessary to restrict many activities by sets of regulations. All persons have the right to know what activities are not acceptable under all circumstances.

Fortunately, under conditions appropriate for international scientific cooperation, modern science and technology have the means to supply much of the knowledge needed to correct actions that have the potential for driving mankind to the verge of disaster.

In order to realize these benefits, it is necessary to formulate a body of authoritative international opinion based on quantitative analyses of the ecological consequences of largescale human activities influencing the welfare of mankind and the environment, thus providing the basis for warning people of potential dangers in time to prevent evil consequences.

Eventually, adequate, internationally accepted ecological regulations must be established to safeguard the further development of civilizations in harmony with flourishing of life in general.

Both man's relation to man and man's relation to nature present profound moral and ethical aspects. These are insufficiently understood, and merit further thoughtful research.

Knowledge of man occupies the forefront of human thought, and all mankind shares a common destiny.

To meet the challenges before us, we must draw on the achievements of the natural sciences and of the humanities, and must base our work on understanding of and respect for the cultures of all people, of West and East, of North and South.

We propose the creation of an international program with the purpose of studying mankind in relation to life in general and to all global problems generated by man's activities.

This is necessary because some human activities have short or long-term consequences, often of a harmful nature. These consequences can harm large populations, or even all mankind. Widespread, long-term effects can impair the welfare of people for generations to come. Hence we must recognize the profound ethical implications of large-scale human activities and point the way to protect our own and future generations from their unfavourable effects.

This protection can be achieved only on the basis of broad, interdisciplinary approaches and with the cooperation of scholars at national and international levels.

For our next steps, we recommend that the Institut de Vie focus increased attention on the problems affecting MAN, especially on the interrelated destinies of all mankind in this dangerous world, with its many ambiguities and contradictions.

We can hope to prepare people for a new, more broadly based role and to adapt new, broader and more humane ways of thinking, without which we may not be able to save our planet.

RESOURCES OF MANKIND

As the people of every nation join in common concern for life on this earth, they find themselves using improvidently and dangerously the very resources on which depend their own lives and those of their descendents for generations to come. All living things of every kind depend for their existence on the gases, waters, salts, minerals and soils of this earth, and on energy derived from sunlight, or less commonly from chemical bonds resident in mineral components. Very precious amongst these resources are the genes of the living world, which determine the hereditary characteristics of every living being. Human life and human civilizations depend on these resources. All living things are interdependant ; and all living things depend, in turn, on the integrity of the non-living resources of this motherly earth.

Man represents a unique species among different forms of life on this planet. Uniquely for mankind, an essential and distinctive set of resources lies in the knowledge, in the experience, in the senses of right and wrong, and in the human wisdom which is often encoded in philosophies and in religions. Creations of the human mind and spirit: the art, architecture, prose, poetry, painting, sculpture and music constitute priceless treasures of mankind. Some of these have been damaged, destroyed or placed in danger by the products of man's improvident practices. Yet, in their entirety, the resources of the human mind and of the human spirit can provide the motivation and the means to protect life on this planet, to preserve our civilizations, and to raise human culture to new heights of achievement and virtue.

Important portions of these great assets of civilization are under threat. As examples, the marble treasures of the Acropolis of Athens and the brilliant medieval and renaissance architectural and sculptural monuments of Krakow are rapidly eroding under the pressures of industrial pollution.

a. Non-renewable Resources

Mankind's activities are now assaulting the irreplaceable natural resources on which civilization is based at rates unprecedented in the history of this earth. The rate of destruction at man's unkind hands is accelerating. In the aggregate, these uncomprehending and careless destructive practices are no trivial matter. We are destroying some of our fine agricultural soils, our productive fisheries, our forests and even important properties of the air we breathe: our air: which protects us to some extent from cancers produced by excessive sunlight and which regulates the temperatures of our lands and oceans, the distribution of rain and snow, and even the areas of habitable land available for our cities, our farms, our recreation and our pasturage.

Let us look at some of the ways in which our short-sighted misjudgements are eroding the bases for life and for civilization. We here suggest an example:

A considerable group of hazards derive from the world-wide use of fossil fuels, represented in coal, oil and natural gas. Thoughtful and informed persons recognize challenges to life resulting from the extraction, the transportation and the combustion of these useful and valuable substances. Combustion of these fuels is leading to a steady accumulation of carbon dioxide (CO_2) in the atmosphere. Careful study has led to the conclusion that this global increase in CO_2 is leading to global climatic changes, characterized principally by an appreciable warming of climatic temperatures on a world-wide scale. Detailed prediction of regional effects of these warming trends poses some uncertainties, but at present scientists anticipate shifts of agricultural production to regions closer to the arctic circle, together with a global rise in sea level of uncertain extent and rapidity, but perhaps amounting to 60 cm, or about two feet, in a century. Such rises in sea level will pose serious problems for low-lying areas such as southern Florida, The Netherlands and coastal Bangladesh.

If the rise in sea level is greater than estimated, or if it continues at anticipated rates for several centuries, the consequences will be even more severe and millions of people may be displaced, their homes becoming seabottom.

The extraction, transportation and combustion of fossil fuels also poses other serious challenges to life. Several thousand persons are killed and many more injured and rendered sick each year in the mining and transportation of coal. Spillage from wrecked tankers, both ships and land vehicles, has spread pollution and danger over considerable areas of coastline and along highways and railways, though recovery has been relatively rapid. Acid water drainage from coal mines and disturbances of top soil from strip mining and from deposits of mine tailings have impaired the productivity of much land, with little recovery. Effluents from smokestacks and exhausts of coal and oil burning plants and equipment spread acid-generating substances, soot and dust, carcinogens, and even radioactive material, in addition to CO_2 , to the peril of life: life ranging from mankind to the vegetation and microorganisms on which many living things depend. The sources of these problems are distributed all over the industrial world, and safeguards sufficient to protect life from the consequences must be deployed globally.

b. Renewable Resources : Genes of the Living World

In nature itself, the world's resources of genes, which have developed, matured and diversified over three billion (three thousand million) years, are eroding and diminishing in richness under the destruction, at mankind's hands, of wilderness areas, and under the effects of pollution of wetlands, rivers, lakes, estuaries, and coastal waters. Once extinct, a gene or a species cannot be replaced or renewed.

The extinction rate of plant and animal species has also been accelerated by human agricultural practices during the last centuries, and the diversity of the inherited characteristics of many crops and

domestic animals has been impoverished by selective breeding in the interests of greater yields. These practices have brought benefits, but have at the same time created perils for future generations. Adequate protection of life in the future require careful husbanding of the genetic diversity of imperiled species, particularly of the major food crops of the world. This must be done on an international scale, in a cooperative manner, in such a way as provide for unfailing maintenance of valuable germplasm and to insure ready availability of genes so stored to qualified persons in all countries, whenever needed.

The rich, diverse stores of genes in the living world are embodied in and influence the destinies of living beings of every kind. These diverse species are, of course, interdependant, and human understanding of the extent; the subtleties and the importance of these interdependencies grows year by year. The ultimate dependence of all living things on the energy of sunlight has long been understood, as has the interdependent nature of plant and animal populations and their joint dependence on the integrity of the atmosphere, the waters and the soils of mother earth. Newer, and growing in significance every year, is our understanding of the extent and the subtleties of the interactions between the genes of the world, and of their importance to human life. The importance of interactions of genes achieved through sexual reproduction has long been recognized. It is now evident that small bits of genic material can be transferred from one microbial species to another. For example, viruses can mediate such transfer. In special cases, bacterial genes of a suitable species can be transferred to cells of many plants species, with resulting altered growth patterns of the plant cells carrying the bacterial gene. The frequency and the diversity of such inter-specific genic transfers is not yet fully known. Though they seem to be rare, such interspecific exchanges can have far-reaching effects.

These considerations lead us to realize that all genes of all living organisms constitute a unique, diverse resource of great relevance to future generations of mankind. This relevance leads to the

necessity of protecting, of safeguarding, and of preserving in all possible detail this essential and irreplaceable resource. For it is now very clear that common basic mechanisms apply to all living organisms on this planet, including man, animals, plants and microorganisms. So viewed, man is a particularly favored member of a very rich, interdependent, extraordinarily diverse population of living organisms.

More than a century of thoughtful research has led to a considerable understanding of the natural history leading to the appearance of vast numbers of species of living things. We understand the origin and the importance of mutations, which are changes occurring at the level of the hereditary material. We also understand that internal and external environmental conditions represent the selective forces allowing certain particular genetic combinations to propagate more readily than others. Hence, the genetic diversity found on this planet today is the result of a very long (about 3×10^9 years) period of diversification and development. We do not understand very well the role of interspecific, non-sexual exchanges of small numbers of genes in this historical development, yet we believe that future improvement of the progeny of a given living organism of today may depend on the genetic makeup of many other, perhaps somewhat unrelated species. These insights into the forces leading to biological development and diversification provide a better scientific basis than we ever had before for evaluating the long range consequences of technological practices on human civilizations.

Thus we see that attrition or extinction of genetic resources may seriously impair the future of mankind.

Important new insights into mechanisms of biological functions accumulate daily from research in molecular and cellular biology. Many of the results obtained are fully unexpected. They surprise the scientists and they deepen their admiration for the natural ingenuity of creation. Many of these new findings will open new

approaches for biotechnological applications. As a matter of fact, such applications strictly depend on previous understanding of the specific mechanisms of biological functions and cannot be envisaged without this insight. This situation is an additional reason for undertaking all possible measures to preserve as many existing genes as possible from disappearance. Many of them might become of relevance for specific applications only in future generations.

Can we make new genes synthetically, by chemical means in the laboratory? With today's knowledge, we do not know how to design a functional gene. Moreover, statistical considerations clearly show that it is not possible to obtain a desired gene by random attempts. Thus we must regard the genes of the living world collectively as a unique and irreplaceable resource which may be of even greater value for future generations than it is for us today. We see before us the clear and inescapable duty, in the name of humanity and of our children's descendants, to safeguard, conserve and protect the genes of the living world as a priceless, irreplaceable treasure for the future of mankind.

What about artificial, experimental manipulation of genes in the laboratory? Experimental recombinations of genic material and the induction of mutations at specific, known, genic locations form the bases for extraordinarily useful experimental and industrial technologies. There is general agreement that possible ecological consequences of such projects require particular attention. This must include risk assessment experiments, particularly in cases of approved, deliberate release of artificially modified organisms into the environment. However, in the general context of natural laws governing directional development of species and their interactions, it seems clear that risks of harm to ecology from genetically altered organisms are minute.

Looking at possible future applications of scientific knowledge for the benefit of mankind, we are of the strong opinion that the full

integrity of the genetic setup of man himself should not be touched by any kind of genetic manipulation, unless indicated by a generally approved medical approach to alleviate a severe congenital disease.

Turning now from a consideration of the genetic setup of man to a consideration of the complex nature of human society, we discover an important parallel. The cultural and ethical diversity of human society is highly desirable and should not be hampered by any regulatory means. We would consider any such restrictive regulations as contradicting the ethical principles forming the basis of human societies.

SUMMARY

The people of the world, through their governments and their appropriate institutions, must join in concern for life on this earth. For we face a rapidly changing world which often uses improvidently the resources on which life itself depends.

All life is interdependent. A vigorous basis for the human spirit and a harmonious and productive society depend critically on a secure basis for all life. For humans share with other living beings the necessity for an adequately protected heredity, for balanced and sufficient nutrition and for prevention of deleterious environmental changes.

The challenges to life emerging from these changes transgress national boundaries and can be met successfully only by concerted action by competent and thoughtful people all over the world.

Scientists in many countries have recognized a number of these severe challenges to life, and have already gathered much useful knowledge, yielding a very helpful measure of understanding. We now realize that the safety of life in the face of these challenges depends on cooperation of people in many nations and on thoughtfully revised use of agricultural and industrial technologies all over the world. But our understanding of these problems achieved so far, though only partial, is nevertheless encouraging, permitting, in some cases, prediction of the effects on life of some man-made environmental changes for relatively short periods of time, perhaps for a century. At the same time, these successes show that much more can be achieved, and for this, much more must be learned. From new knowledge so gained, added to that already available, efforts to protect life can be planned with improved assurance and in a longer time frame than seems to be feasible today.

Mankind's capacity to protect and to preserve life in all its diversity depends critically on adequate understanding of life's processes. These processes in turn depend on the coordinated interplay of many factors, amongst which are the molecules which constitute living beings. Already much has been learned about the general shape, arrangement, and interactions of the molecules within our cells. But further knowledge is necessary, and we must define and map the specific configurations of their electrons and the manner in which each detailed constituent portion of the molecule participates in the harmony of a healthy life. As we do so, our understanding of cancers and of the workings of a brilliant human mind will gain in depth, and our ability to predict the consequences of changes on living things of all kinds will become more assured.

In this brief summary we have set forth a few examples only of some of the challenges which face life on this earth, and which mankind must face in efforts to protect life. Adequate protection depends on adequate understanding of life itself and on the interaction of living things with the surroundings.

It is not sufficient for scientists alone to gain understanding of the complexities of life. Such knowledge should be widely disseminated and made available to the public at large all over the world. Sound understanding of life and of its challenges can lead to sound decisions as to measures for protection of life. The cooperation of governments, of teachers, of the press, of the visual dissemination media, and of persons of good will in all countries will be needed if success is to be achieved.

With brilliant opportunities before us, we recommend that the Institut de la Vie initiate activities designed to bring able scholars of good will from many countries to cooperate in efforts to learn about life, about the challenges facing life, and about measures to improve the future of life. The aim of this effort is to extend understanding of life and its challenges to firmer and more basic

levels, and thus to protect the future of life on this planet ; most specially to protect and to prolong human life in a condition of productivity, health, vigor and creativity.

More detailed analyses and proposals for action relating to actions necessary to protect life from mankind's thoughtless carelessness and improvidence follow under the following specific topic headings :

1. Man and the environment
2. Protection of biological diversity
3. Molecular mechanisms of biological reactions as related to health, disease, heredity and aging
4. Science and Communication, toward a better understanding of science

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SPECIFIC TOPICS

MAN AND THE ENVIRONMENT

The Institut de la Vie recognizes and supports the conclusions and recommendations of the United Nations Conference on the Human Environment held in Stockholm in 1972, together with the programs of relevant national and international agencies, for a better understanding of Man — Biosphere — Geosphere relationship and the protection of the environment.

In doing so, the Institut de la Vie recognizes that the quality of human life depends not only on an adequate balance of the physical and biological environments, but is also closely linked to cultural values of historical and ethical significance which are essential for the mental and social wellbeing of all individuals and for the maintenance of the cultural identity of their own communities.

In that perspective the Institut de la Vie expresses its deep concern that the rising pressure exerted by technology and as human activities on the environment and on patterns of civilization is not adequately considered or controlled, with the result that world resources are being depleted, natural equilibria endangered and traditional life style and economies challenged. It is also recognized that the impact of man-made chemicals on human genetic material is imperfectly understood and that the growing interference of such chemicals with ecosystems might be a significant factor affecting the evolutionary capabilities of living organisms and might result in the extinction of a portion of the biological and genetic diversity on earth.

We are convinced that sufficient fundamental knowledge based on appropriate science can provide a firm groundwork for decision and action, leading to harmonious relationships between development needs, cultural patrimony and environmental values.

The responsibility for implementing those actions lies with policy makers at the national and international political levels. The Institut de la Vie acknowledges that this is a difficult task since, in many environmental issues, scientific knowledge is still insufficient to provide regulatory authorities with firm and reliable guidelines. The Institut de la Vie is, however, confident that increased and sustained multidisciplinary research in the field might help to bridge this gap.

These are the reasons why the Institut de la Vie, considering a limited set of selected cases, calls on the Community of Nations to act immediately on the following points :

1. The Institut de la Vie considers that responsible management of world renewable and non-renewable resources should be carried out on a truly international basis in order to safeguard the interests and patrimony of rising generations and keep a proper balance between industrialized and developing countries, taking into account regional sensitivities such as those of tropical, arctic and sub-arctic areas.
2. Considering that the extensive, uncontrolled use of fossil fuels results in the massive release of carbon dioxide, sulphur and nitrogen oxides, trace metals, soot and organics which not only affect seriously the air quality in the vicinity of the emission sites, but also have regional and global effects that might result in drastically deleterious climatic changes, the Institut de la Vie
 - recommends that developers and policy makers utilize low-pollution energy sources, like natural gas ; foster the use of clean energy manufacturing processes like fluidized bed combustion of coal and lime mixtures and encourage the use of safer and cleaner fuels for transportation including hydrogen and (bio) synthetic methanol ;
 - recommends that the release of fluoro-chlorinated compounds in the atmosphere be abated in order to protect the ozone layer ;

- strongly advises governments to implement the international conventions in existence for the above ;
- recommends that efforts be pursued for energy conservation in all sectors ;
- recommends continued research and development of energy systems having negligible or low environmental impact such as intrinsically safe nuclear systems for large-scale energy production or solar/wind powered generators for decentralized rural areas and dispersed habitations.

3. a) Considering that unpolluted water, readily available in large amounts, is a prerequisite for the development of life, the Institut de la Vie

- recommends that national and international regulations be developed to protect inland water bodies such as mountain snow and ice, lakes and rivers, ponds, marshes... and that international law be amended and improved in order to allow indictment of polluters and redress of victims ;

b) considering also that the oceans are a special part of man's environment since they cover more than 70 per cent of the earth surface, are mobile and shared in common between all nations, whether coastal or land-locked, the Institut de la Vie

- recognizes and supports relevant international conventions and instruments aimed at protecting the marine environment and strongly invites governments to implement a coherent development policy for oceanic stretches.

The Institut de la Vie expresses also its particular concern for those areas of the coastal zone that bear the most important environmental load and strongly recommends that their non-renewable and renewable resources be managed carefully, whilst protecting their amenities and intangibles so that they can remain areas of natural recreation and enjoyment.

PROTECTION OF BIOLOGICAL DIVERSITY

The numbers of species and populations of plants, animals and microorganisms on this earth is enormous. Over the entire natural history of life, the numbers of species have increased and diversified until very recent years — years within the lifetime of many of us now living. Man's activities have impaired conditions favorable for life to such an extent and over such huge areas all over the world that many species have become extinct very recently at man's careless hands. As mankind's actions made conditions for life worse and worse, the rate of extinctions has grown to the point that today, species of living beings are disappearing so fast that at least one fifth of all living species — plants, animals, and smaller living forms — is estimated to be vanished under our assaults during the next thirty years. The rate of destruction is greater now than at any time within the last 65 million years. These are tragic losses. With the disappearance of each species and population, the world loses forever a unique set of genes.

Each species differs from all others in significant respects. Within the individual members of each species, the genes embodied in each individual share most of their characteristics but usually vary to some extent from individual to another within the same species. The degree of variation represented in all members of all species is generally spoken of as biological diversity.

The variations between gene sets represented in all individuals in all species can be termed more strictly as genic or genetic diversity, which is generally regarded as an enormously larger and more diverse set of units than is referred to by the term biological diversity. The greater the biological and genic diversity throughout the world, the better also for mankind.

The rich, diverse, interacting and recombining set of genes represented throughout the world is a priceless and irreplaceable resource of enormous value for future generations of mankind. Humanity and concern for our descendents command us to cease this thoughtless slaughter of our children's children's assets.

How are we bringing about this lamentable attrition of genic diversity? In the main body of this report one can find account of ways in which mankind is destroying its own future wellbeing. Overhunting, overfishing, destruction of forests, wetlands, swamps, pollution of waters and air, urbanization, agricultural practices, monoculture of genetically homogeneous crops, all contribute to this dangerous attrition. Protection of our remaining gene stocks on a worldwide scale would be a blessed gift for future generations, increasing their chances of living in a secure and prosperous world.

On a very small scale we are now conserving in institutional fashion some of the genes important for the world's leading food crops, as well as those of some threatened animals. This is an important and worthy effort, but the world's parks, reserves, zoological and botanical gardens, seed banks, tissue banks and similar institutions constitute an insufficient effort. This is good, but not enough. Most important of all, we must stop the slaughter of the world's diverse genic resources.

At the Helsinki Conference on Security and Cooperation in Europe (1975), the US, the USSR and many other countries agreed that protection of nature and rational use of its resources is essential for human welfare and economic development. Though there is already this international agreement to protect nature, the loss of genetic diversity, at man's hands has not slowed, but has accelerated.

In order to safeguard the remaining but still diminishing genetic resources of the world for future generations, and for humanity's sake, we should:

1. Monitor more accurately the world's genetic assets, determine more accurately the rates of loss of various species, and prepare in computerized form and keep up-to-date an inventory of the

world's living forms, starting with plants, vertebrates and other organisms that are relatively well known or economically important.

2. Participate actively in the ongoing efforts to develop a network of nature reserves throughout the world to safeguard a comprehensive sample of global biological diversity, and share the funding of these reserves.
3. Encourage development strategies and management practices that will lead to the preservation of the maximum biological and genetic diversity, particularly at the population, species and ecosystem levels.
4. Protect the germplasm of plants in botanical gardens and seed banks, employing a comprehensive inventory beginning with plants that are most endangered or of the greatest potential value.
5. Take analogous steps to preserve germplasm of selected groups of animals and microorganisms.
6. Protect the genetic diversity of the major food crops and their related species by unflinching maintenance of their germplasm, especially as seeds, in banks ; rapidly evaluating this germplasm ; making its properties widely available to organisations and individual scientists in computer-readable and printed form ; and distributing the germplasm throughout the world, without national distinctions and preferably without charge.
7. Support, extend, and encourage in every possible way all measures directed towards conserving and safeguarding the world's remaining, irreplaceable living genes.

The Institut de la Vie could make an important contribution to progress in this area by establishing a mechanism for monitoring biological diversity worldwide and the status of the collective efforts to preserve it and utilize it effectively.

MOLECULAR MECHANISMS OF BIOLOGICAL REACTIONS AS RELATED TO HEALTH, DISEASE, HEREDITY AND AGING

The totality of life, a vigorous basis for the human spirit, and a harmonious and productive society all depend critically on sound minds in sound bodies and on adequately protected heredity, all sustained by a balanced and sufficient nutrition.

These in turn, indeed, life itself, depend on the coordinated interplay of many factors, amongst which are the molecules constituting living beings. Orderly arrangements of these substances and well-regulated, intricate and precise interactions between them are absolutely essential for an adequate biological diversity, for successful resistance to and recovery from infectious disease, for avoidance of or recovery from cancer, for proper functioning of the brain, for healthy development of a human being before and after birth and for a prolonged and useful life. In contrast, derangement of certain molecules or imprecision in their interactions can lead to premature mental deterioration, to malformed infants, to hereditary disease, to cancer, or to early onset of disabilities of old age.

As a result of diligent research by many people in various countries, a goodly number of these important molecules have been recognized and characterized and their arrangements and functions determined. Prominent amongst these are the enormously long nucleic acid chains which embody the hereditary principles of mankind and, indeed, of all living things. Careful preservation of these precious and fragile molecules is essential for the proper continuity of our species and for the health of future generations, as well as of persons living today.

The human brain and the developing human embryo likewise depend for healthy growth and proper working on a definite set of specific molecules which serve to carry signals from one cell to another. Sound thinking, balanced emotions and perfect embryonic development depend on orderly and well controlled syntheses, release and recognition of these signalling substances, in which are encoded specific and concise molecular messages.

Already, on a somewhat superficial and descriptive level, much useful knowledge has been gathered, yielding a very helpful measure of understanding. Based on these gains, treatment of cancer, prevention of infectious disease and management of endocrine disorders have improved and organ transplantation has become much safer. But our knowledge and our understanding of the molecular interactions underlying health are still insufficient so that our methods for dealing with disease and for prolonging life and health are still relatively crude and only partially effective, sometimes producing troublesome side effects.

Our achievements so far, though only partial, are nevertheless encouraging. At the same time, they clearly show that much more can be achieved, and for this, much more must be learned. Therefore, special research effort must be directed towards deepening our comprehension of molecular interactions at very fundamental and basic levels.

Towards this end, we must gain more accurate and extensive understanding of the general shapes and arrangements of the molecules within our cells. Further, we must define and map the specific configurations of their electrons and the manner in which each detailed constituent portion of the molecules participates in the harmony of a healthy life. As these molecules serve our bodily needs, they dance and interact mutually with marvelous precision, displaying a grace, flexibility, intimacy, order and timing which, when working perfectly, insure health, but when engaged in disarray, or in imperfect relation or timing, can lead to disease or to damaged heredity.

We therefore recommend the promotion of activities designed to bring able scientists from many countries to cooperate in efforts to learn more about molecular mechanisms of biological reactions related to health, disease, aging and heredity, thus extending understanding of life's mechanisms to firmer and more basic levels.

The conceptual and computational tools of quantum chemistry and molecular dynamics have opened brilliant new prospects. In parallel, there are promising new instruments for measurement and study. Amongst these, recent improvements in nuclear magnetic resonance instrumentation permit measurements of rapid molecular interactions in very minute structural detail and with extraordinary precision of timing. We are learning how to use these powerful methods for analysis of molecular structure and interactions, even in the complex and rapidly changing interiors of cells, whether in health or in disease. When the new knowledge gathered by use of powerful methods such as those just mentioned is integrated more fully with the dramatic advances recently made possible by molecular genetics, DNA technology, monoclonal antibodies and other techniques of cell biology, we shall gain more profound understanding and be able more confidently to extend the effectiveness of measures necessary for the prevention and relief of human suffering and disability.

In using this information to protect human genetic material and life in general on this planet, we will encourage the protection and prolongation of human life in a condition of productivity, health and vigor.

— Specifically, and initially we recommend that the Institut de la Vie organize conferences and encourage other approaches with the aims, on the one hand, of extending basic quantum and thermodynamic approaches to biological molecular systems towards the most basic, fundamental levels, and on the other hand, of coupling these basic concepts to the structure and functionings of large, whole molecules and of molecular assemblies

such as constitute genes, enzymes and other working units in cells. In this manner, the ways in which the basic laws of physics and of thermodynamics operate in living cells can be clarified further and of our understanding deepened.

We recommend further

- that support be given to the work of the International Commission for Protection against Environmental Mutagens and Carcinogens (ICPEMC) on the application of the results of studies on molecular mechanisms to the evaluation of factors affecting human genetic material in terms of hereditary disease, cancer and aging ; and
- that intensified efforts be made to coordinate and extend the results of modern biomedicine in order to obtain more profound understanding of the processes underlying the sudden emergence of diseases such as AIDS. Further understanding of the spread of AIDS may help us deal with this epidemic more effectively, and improve our capacities to anticipate, prevent, reduce or control the spread of newly-emergent epidemic diseases in the future.

SCIENCE AND COMMUNICATION TOWARD A BETTER UNDERSTANDING OF SCIENCE

Science plays a very important role in contemporary human society and modern civilization. For instance, without science and its various applications in advanced technology the world could not support its present population, much less the populations projected for the future.

One of the challenges of science in the contemporary world is communication.

It is paradoxical that a large part of mankind does not understand the nature and the value of science and that scientists, fragmented into different disciplines, often do not have enough opportunities to communicate effectively with the decision makers, with the general public, or even with one another.

An important mission of the Institut de la Vie is to help to resolve this paradox by bringing science more fully and accurately into the consciousness of man. The Institute strives to develop a better appreciation of science as interpreter and servant of life.

Science is an integral part of human culture. Public understanding of science should reflect its true importance. At the level of scientific books and journals, the situation is relatively satisfactory. But a great many people get their view of the world from the mass media, which often fail to convey an adequate appreciation and understanding of the nature of science. The quality of the mass media is particularly important, as there is danger that decisions at different levels may be made on the basis of insufficient information or unsound interpretations of data.

The Institut de la Vie is aware of the problems faced by governments when some farsighted but unpopular decisions must be taken. In most countries public opinion plays such an important role that it is impossible to undertake sound and scientifically justified measures for protection and enhancement of life unless they are well understood and supported by the general public.

It is of great importance to transmit to the general public a realistic, balanced picture of scientific results without creating unjustified fears and anxieties and without raising false hopes and expectations.

In addition to improving the public image of Science through mass media, modern societies must seek to advance the formal education of the young, both in basic science and in humanistic subjects necessary for relating science to human values. If the basic concepts are taught early, student have options as to which subjects fit their particular interests and inclinations. If they choose subjects outside of science, they will still come into adulthood with a better capacity to relate science to other aspects of life.

RECOMMENDATIONS

The Institut de la Vie can help to solve some of these problems by

- urging governments to give higher priority to science
- encouraging scientists to play an active role in the proper presentation of their work
- expanding the number of summer schools, courses, seminars and fellowships for journalists specializing in science reporting
- extending the scope of the world-wide mass media programs concerning the value of life and examining important aspects of life

- investigation of the best methods of presenting scientific information to the general public in such a way as to avoid creating unjustified anxiety
- establishing guide lines for scientists and journalists in their communication with the general public.

These measures can be at least partly implemented by the creation of an International Center of the Institut de la Vie.

The group also considers that it would be highly advantageous to have some kind of « International Scientific Press Agency » capable of advising the media on major scientific and technical issues and events.

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