ANTONINO DRAGO*

# A radical suggestion on science in a democratic society

ABSTRACT. ISIS' initiative for a "Convention on Knowledge" is sketchily illustrated. The preparatory document proposes in technologies and fields of scientific research on one hand drastic cuts and on another hand new improvements. In order to qualify its proposals, the document is then analysed according to a perspective of a historical change introducing us in of society of a pluralistic kind, as well as in the recognition of a variety of foundations in science; such a recognition decisively will phase out the traditional scientific paradigm which at present is monopolizing the entire science in one foundation only.

## 1. The initiative for a Convention on Knowledge

In winter 2002 Dr. Mae-Wan Ho of the ISIS[1] - an institution involved in the debate on the scientific evidence of hazards inherent to genetic engineering - suggested a document which was sponsored also by the Scientists for Global Responsibility (SGR)[2] and Third World Network (TWN);[3] then it was adopted by International Network Engineers and Scientists for Global Responsibility (INES, the largest network of scientists in the world) and the Tentebba Foundation (umbrella organisation representing all indigenous peoples).

The document calls for a "*Convention on Knowledge* [, i.e.]

> a 'coming together' both of civil society and of issues on knowledge that will have major impacts on the agenda for global sustainability.... 'Knowledge' is to read in the widest sense to include all knowledge systems that exist in the world today, to underscore the holistic nature of knowledge systems and their independent and equal status. Thus, 'knowledge' in the west will include science and other ways of knowing, whereas for indigenous communities, 'knowledge' might be synonymous with 'indigenous science'.
>
> Focusing on knowledge also stresses the important point that knowledge is not independent of technology, or the application of science. Knowledge inspires and guides and misguides technology. This is as true for western science as it is for holistic indigenous knowledge systems."[4]

The document was presented in January 2003 at Second Porto Alegre Earth Summit; it resulted one of the most suggestive proposal sorted from the assembly.

In order to justify such an extraordinary initiative the paper stresses several points, among which the first one is the dominant role played by knowledge in the power system in world society, and nevertheless its decadence for giving room to a forthcoming new scientific epoch.

> 1) The predominant model has failed [this point will be considered later]. 2) [The need for a strong linkage among] Science, ethics and precaution. 3) Corporate science endangers lives. 4) Independent science and scientists becoming extinct. 5) Destruction of indigenous knowledge. 6) Globalisation and biopiracy[5]

---

* Dept. Physical Sciences, Univ. "Federico II", Naples, Italy, adrago@na.infn.it
[1] Institute of Science in Society, ISIS: Dr. Mae-Wan Ho, PO Box 32097, London, NW1 0XR, UK, e-mail: m.w.ho@I-sis.org.uk. telephone: [44 20 8643 0681] [44 20 7383 3376] [44 20 7272 5636].
[2] Scientists for Global Responsibility, SGR: Dr. Phil Webber, PO Box 473, Folkestone, Kent, CT20 1GS, UK. Email: PhilW@sgr.org.uk.
[3] Third World Network, TWN: Mr. Martin Khor, 228 Macalister road, 10400 Penang, Malyasia, e-mail: mkhor@igc.apc.org.
[4] I will quote from the document in a scattered way. This term 'knowledge' is illustrated in a more detailed way along an half page.
[5] Let us note that this position is very radical when compared with Polanyi's, Popper's, Fuller's; see e.g. Jarnie 2001.

Moreover, the following points are remarked by viewing science from inside of it:

> 1) Suppressing dissent inside science. 2) Corporate takeover of science brokered by governments (Governments have sold science and scientists to the corporations). 3) Science behind closed doors. The academic-industrial complex is not open to public scrutiny. 4) Corporate science kills too. 5) Scientific journals closed to debate. 6) 'National GM debate'[among scientists] is a farce.

Surely the promoters of the initiative have to be thanked; they courageously manifested a position opposing a variety of stereotypes on science; moreover they promoted a debate on a so relevant social theme.

**2. The suggestion for drastic cuts on science and technology**

The importance of the document is given by not only its lucid and up-to-date criticism of the present state of research in the world and mainly about the hottest question under debate - biotechnologies -, but also its proposal for radical cuts in scientific research and technologies.

> 1. Technologies that should be banned: Nuclear weapons. Biological weapons.Chemical weapons
> 2. Technologies that should be phased out: Nuclear power stations. Fossil fuel. Antibiotics in agriculture. Agrochemicals: chemical herbicides, pesticides, fertilizers.
> 3. Technologies that should be subject to international peaceful control: Genetic engineering. Nanotechnology.
> 4. Research that should be discontinued: Any research in weapons of mass destruction, chemical and biological warfare. Xenotransplantation. Genetic modification of animals for agriculture, pharmaceutical and industrial productions. Genetic modification of plants released into the environment for agriculture, pharmaceutical and industrial productions. Terminator technologies (genetic engineering for reproductive sterility, either in seed, pollen or ovule). Gene therapy. Human cloning, including 'therapeutic' human cloning

Let us remark that military technologies are mentioned as first, because the military sector in society is the most powerful sector in promoting social development. Already in the 60's the Report from Iron Mountain (maybe by J. Galbraith) stressed that in the present time a war is won by the leading nation in scientific research, rather than industrial development. In the past, the close link between military research and civil research was mainly manifested by nuclear power; at present this link is surely reiterated by genetic research. The previous list represents a detailed programme for reducing scientific research and technologies.[6]

**3. The suggested way forward**

The document's proposals are not only in the negative direction, but also in a positive way to promote research and technology, according to the following guidelines.

---

[6] In a different part of the document some general recommendations are added: "Apart from the obvious criteria that the technologies should not be harmful or toxic, there are other features to consider. They should respect human rights and ethical concerns of society. They should not compromise the conditions of life for future generations while benefiting the present. They should be affordable and genuinely improve the lives of all, and not just the rich. In the biomedical realm, for example, this would set a policy for minimum intervention technologies that are effective, that would also minimise the costs of patented procedures and products. One criterion that is perhaps not so obvious is that the technology should not compromise people's autonomy and choice, that is, people should not be coerced into using the technology. This is particularly relevant to genetic diagnostic tests targeted at 'defective genes' that discriminate against individuals or the unborn, or DNA databases that compromise people's rights to privacy. Other situations might involve nano-technological implants that cannot easily be removed by the user".

> We need to substantially alter the way knowledge is acquired and applied. In particular, we need to transform the way scientific research is conducted in the west as well as the areas funded….
>
> [First,] Scientists should work much more closely, if not directly, with local communities…
>
> [Then, the list presents the part of] Science and technologies that should be supported. There are many existing technologies that will make valuable contribution to sustainability. Rather than attempting to produce an exhaustive list of such technologies, we identify them in the context of two areas that desperately need to be funded. Ecology and energy use in sustainable systems…
>
> Not as well acknowledged are the following topics: Complexity and bio-diversity in agro-ecological systems. Energy-relationships, energy use and renewable energies. Concept of 'waste' and sustainability. Renewable energy generation and bio-degradable technologies. New forms of public ownership. Minimum waste generation and efficient processes in agriculture and industry. Novel ecological accounting procedures for sustainability. Biophysical indicators of ecosystem health and monitoring technologies. Decentralised energy-efficient technologies that promote local autonomy and participation. Social environmental indicators of sustainability. Localisation and regionalisation versus globalisation. Science of the organism and holistic health
>
> Many new research programmes fall potentially within the general area of "science of the organism"… We have identified the following topics: Biophysical model of the organism. Understanding complementary and alternative medical practices. Concept of holistic health that includes the social and ecological environment. Biophysical, dynamical indicators of health. Social and environmental indicators of health. Non-invasive, non-destructive technologies for monitoring health and food quality. Effective therapeutic methods based on minimum intervention. Criteria of appropriate technologies….[7]

### 4. The origin of the suggestions: the criticism of the past paradigm

The technologies to be banned or phased out according to this programme surely interprets mankind's feelings of possible threats; but their number is considerably high. One can well conceive a world where technologies are reduced; but do present scientific research will accept the above drastic cuts? This policy is commonly opposed by a serious objection, concerning the prominent social role played by scientific research in leading human society; since scientific research is commonly believed to be the main expression of rationality.

Hence, it is relevant to list the arguments which are offered by the proponents of the document at issue about the role played by science in society. It is recognised that its role was a progressive in nature; but in past centuries only.

> The advancement of science - the predominant knowledge system of the West - has been linked historically with progress and civilisation, and general improvement of the lives of the masses, at least up to the beginning of the twentieth century. World War II and the atom bomb shocked the world into recognising that science and technology can be instruments of mass destruction. Still, the idea lingered that science is beyond reproach, and it is technology that has to be controlled. And so the atom bomb, explosives and nerve gases were turned into nuclear reactors, fertilisers and pesticides respectively, all regarded as beneficial peacetime uses. Rachel Carson's Silent Spring sounded the first warnings that the earth and all its inhabitants were being poisoned, and will be, for decades to come, unless those uses were discontinued.

At present the role played by science is viewed as radically changed, so that one can state that:

> Mechanistic science and big business share the same ideology.
>
> The increasingly intimate alliance between science and big business has deep roots. The predominant framework of western science is mechanistic and reductionist. The machine metaphor in biology dates back to Descartes' concept of the body as machine, separate from mind. Darwin's theory of evolution by natural selection proposed that species evolve and improve over time due to the all-pervasive competition of one against all and all against nature. Darwin was inspired by the

[7] As an instance of these proposals in the case of agriculture, see the paper suggested by ISIS itself, Pimbert 19??.

laissez-faire economic theory of Adam Smith, in which competition and the 'free' market – expanding under the military might of the British Empire - was seen to be the key to economic success. Darwinism, and neo-Darwinism, in turn inspired the present day neo-liberal economic theory, a more extreme version of Adam Smith's, as it involves unfettered competition, not tempered by moral restraint.

The system of economic regulation and agreements set up after the second world war allow companies to operate without responsibility or accountability. This same ideology is currently driving economic globalisation that will have devastating consequences on the livelihood of the poorest and the survival of the global ecosystem.

This two-way connection between science and society is the clearest demonstration that science is not neutral or value free as has been widely assumed. It also opens the way to changing society through another kind of science.

After having broken the myth of a socially neutral role played by - mainly biological - sciences, the document tries to penetrate inside the science itself, by examining more than just biological sciences.

Holistic, organic sciences [are] emerging.

It was the failings of the dominant knowledge system that brought fifty thousand to the streets at the World Trade Organisation conference in Seattle in November 1999, which galvanised the anti-globalisation movement. The dominant paradigm has also failed within science. Across the disciplines, from the study of complexity in mathematics and co-operative phenomena in physics to the 'fluid genome' in molecular genetics, the mechanistic conception of nature has been found thoroughly inadequate.

After these short notes, the discourse turns to positive science, mainly in the biological fields.

Western science is facing its greatest challenge, to transcend the ruling paradigm to holistic, ecological perspectives that can foster the necessary shift to sustainable ways of life.

Many individuals and local communities are already changing their own lives and the world around them for the better. They do so by learning from nature, and recognising the harmonious, symbiotic, mutualistic relationships that sustain ecosystems and make all life prosper, including the human beings as active, sensitive participants in the whole ecosystem.

The same organic revolution is happening in western science over the past thirty years. Lovelock' s Gaia theory, for example, invites us to see the earth as one super-organism with a geo-physiology that maintains it in a dynamically stable state. This is an acknowledgement that we are ecologically entangled with all life on earth.

Even more remarkable, for some of us, is the message from quantum theory: that we are inextricably entangled with one another and with all nature, which we participate in co-creating. It restores and reaffirms the holistic perspectives that many indigenous cultures have never lost touch with. At the same time, it provides a western scientific perspective that can begin to connect with indigenous health and food production systems and practices, offering much scope for creative partnerships between western and indigenous knowledge.[8]

Thereafter, the discourse depicts a desirable perspective, which is attached to a new scientific paradigm.

A holistic science for the west has the potential to transform the meaning and texture of the lives of all who live under the dominant knowledge system, and to create a social reality that genuinely

[8] In a different place similar concepts are reiterated: "But western science itself is undergoing a profound paradigm change towards an organic perspective that has deep affinities with indigenous knowledge systems around the world. We have all the means to bring a truly sustainable and equitable world into being, only the political will is missing".

serves the emotional, spiritual and physical needs of everyone. It would capture the common values that underlie the immense cultural diversity of our species.

**5. Which new paradigm?**

In my opinion, the document is the best one written according to the current criticism to science in its relationships with society. It essentially emphazises a turning point in the development of Western civilization, substantiated by a paradigm change in science. As an application, the document courageously asks for both drastic cuts in present science and the development of new areas of research.

But I see two main questions; the document is hardly acceptable by common scientists and the new address for scientific research is not sharply defined.

Surely, dominant social powers - industrial corporations, trade unions, financial world - will fiercely counterattack its proposals for drastic cuts in technologies. One has to hope in the force of reason only, in order to prevail on the established social powers.

However, one has to recall that all criticisms to negative technologies are commonly rejected as referring to the *social uses* of science rather than to *science itself:* although scientific applications may be negative, democratic political powers are capable to regulate them; while pure science is instead neutral and it has not to suffer hindrances from applied science.

Only a clever arguing upon pure science can empower the present minority position of the critics of present science. The document supports his criticisms by several philosophical remarks. In particular, the following philosophical notions play decisive roles: global, holistic, ecological, harmonious, symbiotic, entangled with one another and with the nature, participating in co-creating etc. Surely, the arguments of the document have been conceived to communicate basic issues to mainly a general public, that does not want technicalities. But the document has to address mainly the scientists, because it would be difficult to obtain any support by public opinion for a drastic change in science, when scientists' majority will defend the basic features of present scientific research. At present most scientists reject all non-scientific evaluations on science as coming from an obscurantist opposition to a progressive path leading to a better future for mankind.

About this point the document invokes an alternative science, which to most scientists appears as highly controversial since it is capable to present an alternative development of scientific research in a sketchy way. Its mentioning of indigenous scientific cultures does not give more explanations to scientists. A suggestion for a new kind of science without technical details can be appropriate to biological sciences, where there are no cogent technical features of a theory; but it is inappropriate to hard sciences, where mathematics plays a crucial role and a theory is organized in a systematic way since a lot of time. The document recall both chaos theory and Bohm's interpretation of quantum mechanics; being these subjects a matter of dispute, both do not suggest a point of common agreement.

In the document the more qualified notion in scientific terms is the idea of a new paradigm in science; it comes from a celebrated analysis on the development of classical physics (Kuhn). The document underlines several negative aspects of present paradigm and some positive aspects of a new paradigm. But the document invokes this change in a loose way. According to the historian proposing this notion, a paradigm shift is preceded by an anomaly. What constitutes the anomaly of present paradigm is not suggested by the document. Moreover, according to Kuhn the comparison of the two different paradigms, the previous and the subsequent one, shows radical variations in the meanings of basic notions. No such an analysis is offered by the document.

Without a better qualification in technical and scientific terms this document may be charged with being based on wishful thinking, and lacking of a detailed programme of both scientific and social reforms.

**6. The debates on energy strategies**

Which strong reasons can be offered to people pro a radical change in science? It is surprising for me that the document does not supports its arguments by the results achieved by the previous great public debates on technological and scientific subjects. First of all, the debate in 70's on nuclear power and energy strategies.[9]

The great experience acquired by the energy debate constitutes much more than a philosophical criticism to old science. This debate led us to discover three main points. First, this theme, although of a scientific nature, plays a basic role in planning modern society; moreover, it presents a sharp dichotomy in energy technologies, between the nuclear ones and the renewable ones; so sharp and detailed to allow to oppose to each issue in the 'nuclear' planning, an alternative issue in the 'solar' planning. In more scientific terms, the world problem of energy planning taught us that there exists a sharp dichotomy between the high-temperature sources and the low-temperature sources.

Even more surprisingly, this dichotomy belongs to the core itself of the most hard science, i.e. Physics. The American Physical Society discovered[10] that along 150 years the very core of thermodynamic theory was disregarded by scientific and technological milieus. This fact manifests a dichotomy even in the historical development of science, between a dominating trend supported in the past by Newtonian mechanics and at present time by elementary particles, and the minoritarian attitude of thermodynamics. To a nuclear theory suggesting a 'free and unbounded energy'' is thus opposed thermodynamic theory, suggesting a wise use of energy through the entropy principle, which remarkably represents an impossibility principle.[11] Notice that this dichotomy includes as a particular case the dichotomy, of a philosophical nature rather than scientific nature, suggested by the document (between a mechanist attitude and a holistic attitude).

Let us remark that the resulting deep cut on nuclear power can traced back to a dichotomy belonging to pure physics. I admit that the energy debate concerns physical science, not biological sciences. But being not proved at all that physical dichotomies are severed from the dichotomies which are possible in biological sciences, I ask: Why exclude the energy debate, which moreover constituted an anticipation of the subsequent great debates on scientific themes?[12] Hence, let us to investigate along this direction.

**7. The blocked knowledge on foundations of Mathematics and Mathematical Logic**

But how to improve previous debate in order to achieve a dichotomic vision of science as a whole? An inspection upon the present debate on the foundations of science leads us to take in account two sharp dichotomies in the hardest fields of science, i.e. Mathematical Logic and Mathematics.

---

[9] Actually, this point is lacking in all new proposal for a new image on science presented in past two decades; in particular, in biological scholars.

[10] AMP 1975.

[11] The opposition concerns also their kinds of mathematics. In the former case, the differential equations, based upon the classical motion of an infinitesimal, directly linked to the notion of actual infinity. In the latter case the elementary mathematics, which can be put in correspondence with physical operations. More details in my paper Drago 1988.

[12] One more great public debate about a scientific and technological theme regarded the arms race in the time of the Euromissiles. In this case two different ideologies shared the same rationality of a nuclear balance, both running towards an infinite amount of destructive power. In opposition, it was the rationality of both confidence and cooperation, shortly solidarity. In fact, latter rationality won in 1989. Then, the mankind was free from the threat to its survival. Hence, the past experience about the problem of arms' race taught us that there is a sharp dichotomy between nuclear weapons (cumulated by both superpowers) and non-violence (suggested by Gandhi and then supported by several peoples in 1989). Commonly, this dichotomy is disregarded since it does not appear so much scientific in nature. But about this point the anticipatory paper by M. Nagler [1981] is enlightening.

In Mathematics a celebrated investigation on the history of hard sciences in general gives support to a dichotomy as pertaining to mathematics. By analysing the birth of modern science, Koyré illustrated a sharp dichotomy between some scientists making use of actual infinity (Cavalieri, Newton) and some others making use of potential infinity only (Galilei, Huygens, partly Descartes). The first attitude prevailed through the intensive use of infinitesimal analysis, which was based upon the notion of an infinitesimal as the inverse of the actual infinity; whereas geometers wanted to maintain the certainty of the operative tools of ruler and compass. In 19th Century Cauchy started a "reform" in order to purge mathematics of so embarrassing notion; he originated the so-called "rigorous", or ε-δ mathematics. Again, this attitude seemed to obscure all other attitudes so that current teaching presents only this one. But its use of actual infinity was emphazised by the introduction of Zermelo's axiom; this kind of mathematics actually makes use of actual infinity; an accurate inspection shows that current teaching introduces actual infinity since the presentation of irrational numbers, or since the presentation of set theory at primary school; the university student is educated by rigorous mathematics to make use of actual infinity in defining the process of a limit, inasmuch as inside the δ intervals he chooses a final point with an absolute accurateness as the final result of the given series.

On the other hand, since the beginnings of 20th century some mathematicians tried to found anew mathematics, by rejecting the use of this notion. Eventually, in 1967 these mathematicians successfully represented the counterparts of a great part of the traditional body of mathematics. A "constructive mathematics", which is bound to make use of potential infinity only, was then developed in a detailed way.[13] Hence, even Mathematics cannot more claim to always represent an unique truth.[14] A basic dichotomy is substantiated by the use of either classical mathematics or constructive mathematics.

The same can be reiterated about Mathematical Logic. It is a century that the foundations of Mathematical Logic started to be severed in various schools: modal, intuitionistic, minimal, positive, quantum, monotonic, linear, default, etc. Since the 30's the program to reduce one logic to another one by means of an operation likely as an inclusion relation has been proved to be impossible; Kolmogoroff-Glyvenko-Goedel's translation from classical logic to intuitionistic logic resulted to be a landmark of this research: a sure translation is possible in a particular case only (the propositional calculus), whereas the gap between the two kinds of logic resulted to be of an infinite nature.[15]

In Mathematical Logic the dichotomy is mainly between classical logic – where the law of double negation holds true –, and intuitionistic logic (together with the weaker kinds of logic) - where this law may fail. Moreover, let us consider that D'Alembert[16] and then Lazare Carnot[17] proposed a corresponding dichotomy, between a deductive organisation and an “empirical” organisation of a theory; the latter one being of a global nature, like thermodynamics (whose holistic alternative was born already 150 years ago!). With slightly different words this dichotomy was reiterated by Poincaré and Einstein.[18] It is easy to show that classical logic manages the deductive organization of a scientific theory; whereas intuitionistic logic is specific for the latter kind of organization.[19]

---

[13] Bishop 1967.

[14] B. Russell said that mathematicians do not more agree about even what is the number one. Historical books by M. Kline are the best references for suggesting a first introduction on this subject. In past years in *J. Phil. Logic* appeared a harsh debate concerning the applications of mathematics on natural sciences. Even the most sophisticated objections against the sufficiency of constructive mathematics have been proved to be ineffective. I suggested a solution to this debate in Drago 1991.

[15] Prawitz, Melmnaas 1968.

[16] J. D’Alembert: "Elemens", in D’Alembert and D. Diderot: ***Éncyclopédie Française***, **17**, 1754.

[17] L. Carnot: ***Essai sur les Machines en général***, Defay, Dijon p. 101-103.

[18] Esposito 1997.

[19] Drago 1991.

I discovered the above two dichotomies more than ten years ago. By taking them as two interpretative categories, I re-constructed almost the whole historical development of Mathematics and Physics. A new history of science emerged; of course, this history is no more the commonly conceived one-dimensional history, but it is articulated in several model of scientific theories mutually conflicting; e.g. the domination of Newtonian paradigm was actually contrasted by the scientific attitudes of Leibniz, Lazare Carnot and Sadi Carnot, in founding respectively mechanics and thermodynamics.[20]

All this deals with inorganic sciences. But also the foundations of Freud psychoanalysis, homeopathic medicine, bioethics and strategic theories can be reinterpreted according to the above two options.[21]

Summing up, the above notes are sufficient for indicating a more accurate direction of reflection and investigation on science in present times, than the ISIS document. in order to discuss the basic problems of science one has to take into account, together with the philosophical dichotomies - say, between bad science and good science; or between regressive science and progressive science; or between local and global science, or between mechanistic and holistic science – the above-illustrated two dichotomies, which belong to the very foundations of the hard sciences.

**8. A new look upon the suggestions for a way out**

Several decades passed from the above-mentioned decisive events, but to my knowledge almost no University course allows the students to know the various kinds of both logic and mathematics logic by stressing the radical differences among the alternatives. I think that these arguments are more decisive than the document's ones in supporting that the whole science - Physics, Mathematics and Mathematical Logic - is undergoing a profound paradigm change.

But which kind of paradigm change? A substitution move, likely as the series of substitutions in the war among kings? Instead, the above illustrated dichotomies suggest that the paradigm shift has not to be conceived as a change of the theory which before and after the change plays the role of the dominating scientific theory, i.e. as if the old dominating scientific theory (say, the mechanistic theory) will be superseded by a new dominating scientific theory (say, holistic science, or 'green' science).

Already the History of Mathematics taught us that one theory only is insufficient for embracing the foundations of all theories of the same scientific branch. After the birth of set theory – which was claimed to embrace all mathematical theories – Frege, Hilbert and Brouwer proposed programs, i.e. much more than a single theory. Even those mathematicians wanting to disregard the very foundations of Mathematics, like Bourbaki, put at the basis of mathematics *three* independent mathematical *structures*, not one theory only. We have to conclude that even in the most assured science, Mathematics, no single theory can cover all the current possibilities.

According to the above my remarks, the present paradigm shift will change our image of science from a one-dimensional perspective to a pluralism of scientific theories; i.e. the paradigm shift will destroy the same notion of a paradigm for allowing to a coexistence of competing directions of development; in the new situation, all theories have to be considered on the same foot. In other terms, the new perspective is to enter in a pluralism of scientific theories according to which diversity will be the common rule. Let us remark that since the years 60's in Western society this pluralistic situation was already operating in the fields of medicine and agriculture; where at present new practices and scientific principles co-exist (although not in University courses!) with the traditional, chemical practices.

---

[20] Drago 1994, 1996.

[21] Drago 2000a, 2000b, 2002. In particular, I qualified both the set of usual bioethical principles and Jonas philosophy according to these two options. However, the extension of this interpretation to Biological sciences has to improved till up to find out a sharp definition of the corresponding two dichotomies.

**9. A new look upon the suggestions for drastic cuts**

Let us apply what was developed in the above in order to meet the problem ending the document, i.e. to compile a list of those issues, pertaining to the dominant science, which xcan be qualified as negative for society and hence to be dropped out, as well as a list of issues pertaining to alternative science to be developed in a decisive way. By assuming a fourfold variety in the foundations of science, the problem of appraising the relationships between science and society is inevitably more complex than when one consider a substitution move in the paradigms. However, the list presented by the ISIS document surely represents a good approximation. But the above notes suggest to add to it some qualifications.

In such a situation of a general pluralism we meet two new basic problem. In order to maintain notwithstanding the many scientific diversities a common society, scientific people have to agree upon some common points; on one hand some indisputable points, and on the other hand some more *ad excludendum* points; which in order to preserve common goods for mankind, exclude the extreme directions of the scientific research and technologies; these can be synthetized, according to previous dichotomies, by means of a scientific research both pursuing a mythical progress and addressed to oppress both nature and society.

This point is important; unfortunately it is not illustrated by the document. It is necessary to achieve a basic agreement among all the citizens of the world; otherwise, it will be futile to exclude some dangerous technologies or scientific researches in one country only, or in a social group only. This point stresses the necessity in the world of a democratic process as leading mankind to achieve a general agreement about some crucial points assuring the human survival together with a peaceful living together. As a whole, a democratic process will decide in society which kinds of research's results will be more suitable for the humans living together.

Only when we have defined the specific technologies to be banned by the whole society, we can suggest a specific way to develop science according to specific foundations. In particular, in a green model of society science too can be characterized in a 'green' way according to the preceding dichotomies: (defensive defense) solar energy and thermodynamics, constructive mathematics, intuitionistic logic. Of course, the above-mentioned appraisals on what constitutes extreme directions in science are more radical when formulated by the social green group; in this sense the science of green group will exclude many more kinds of technologies and fields of research, whereas it will improve many more positive scientific trends. This science is characterised in a similar way to what is presented by the document, i.e. as a holistic science, but in a more accurate way.

The second question is to offer to society at least as much is asked to ban. A constructive effort in order to progress science in the green direction is essential for convincing a democratic society that the drastic cuts in some branches of scientific research is not originated from an iconoclastic programme. Correctly, the document presents first a list of the improvements to give to present research and then a list of cuts to give it.

According to the two options above-mentioned it is easy to qualify in an improved way the list presented by the document; i.e. to recognise in each issue of technology or scientific research to be banned an extreme direction of the two specific choices of the dominant scientific paradigm; or viceversa, to recognize in each issue indicated as an improvement to renewing scientific research one of the two alternative choices. This task is performed in the following Appendix.

A hard question is which kind of public support the different kinds of scientific researches have to receive. Surely, no public support has to be offered to the scientific research to be excluded. But the question is difficult when concerns how to distribute the public support among the different foundational directions of scientific research. About this point ISIS document is silent. On the other hand, the present situation about the financial funds for research on OGM leads to thinking in a pessimistic way. But when a more qualified proposal of the alternative will be presented the public powers can be helped in recognising - through financial

supports too - the public relevance of the alternative in both technologies and science; just the kind of qualification I tried to do in the above.

## Appendix: The drastic cuts and the way forwards according to ISIS

In the following the part of the ISIS document presenting both the improvements and the drastic cuts to give to scientific research, I add at the starting of each issue the corresponding choice implicitly informing this particular issue. The reader will appreciate the agreement of the intuitive scheme achieved by ingenuity by ISIS scientists and the nature of the corresponding choice out of the four ones generated by the two options.

I recall that the choices AI and PI concern *two kinds of development human relationships* (intending them either in a mythical way till up to consider humans as mere things, or in an anthropological way); whereas the option PO and AO concern *two kinds of organization* (intending it either in a self-reliant way or in an authoritative way). They generalize the scientific choices, illustrated in the above sections, to the social cases. The study-case of energy debate makes apparent these meanings.

**"The way forward**

We need to substantially alter the way knowledge is acquired and applied. In particular, we need to transform the way scientific research is conducted in the west as well as the areas funded.

**Working science partnerships**

[PO] Scientists should work much more closely, if not directly, with local communities, in order that people's concerns and aspirations can help shape the research. More importantly, scientists could benefit greatly from local knowledge. Top priority must be given to revitalizing and protecting traditional agricultural and healthcare systems from biopiracy and globalization, and to developing sciences and technologies appropriate for the community.

[PO] We recognize that not all research could be done with or within local communities. But even for research that is largely laboratory-based, the scientists should maintain close touch with the community of which they are part, and be responsive and sensitive to people's concerns.

**Science and technologies that should be supported**

[PI] There are many existing technologies that will make valuable contribution to sustainability. Rather than attempting to produce an exhaustive list of such technologies, we identify them in the context of two areas that desperately need to be funded.

**Ecology and energy use in sustainable systems**

[PI] Sustainable systems refer ultimately to entire ways of life, including agricultural and industrial production, transport, health and economic and social relationships. Of course, subsystems within the whole could also be studied in their own right. The need for energy efficient production and transport technologies is widely accepted. Not as well acknowledged are the following topics:

- [PI] Complexity and bio-diversity in agro-ecological systems
- [PI] Energy-relationships, energy use and renewable energies
- [PI] Concept of "waste" and sustainability
- [PI] Renewable energy generation and bio-degradable technologies
- [PO] New forms of public ownership
- [PI] Minimum waste generation and efficient processes in agriculture and industry
- [PI] Novel ecological accounting procedures for sustainability
- [PI] Biophysical indicators of ecosystem health and monitoring technologies
- [PO] Decentralized energy-efficient technologies that promote local autonomy and participation
- [PO]Social environmental indicators of sustainability
- [PO] Localization and regionalization versus globalization

**[PO] Science of the organism and holistic health**

Many new research programs fall potentially within the general area of "science of the organism." The emphasis is on non-linear complex dynamics, feedback and coherence, which are necessary for understanding complex systems in general. Especially important is the scientific underpinning of complementary and alternative medical practices, in view of the fact that homeopathy is entering mainstream medicine. The biological effects of mobile phones and other electrical installations in the environment, for example, also requires an appropriate biophysical understanding of the organism. We have identified the following topics:

- Biophysical model of the organism
- Understanding complementary and alternative medical practices
- Concept of holistic health that includes the social and ecological environment
- Biophysical, dynamical indicators of health
- Social and environmental indicators of health
- Non-invasive, non-destructive technologies for monitoring health and food quality
- Effective therapeutic methods based on minimum intervention.

**Criteria of appropriate technologies**

Although it is not possible to predict discovery and inventions, the above considerations do allow us to make certain judgements concerning which technologies are appropriate for society, not just at the stage at which the technology is ready for use, but especially at the research and development stage.

[AI} Apart from the obvious criteria that the technologies should not be harmful or toxic, there are other features to consider. [PI] They should respect human rights and ethical concerns of society. [PI] They should not compromise the conditions of life for future generations while benefiting the present. [PO] They should be affordable and genuinely improve the lives of all, and not just the rich. [PO] In the biomedical realm, for example, this would set a policy for minimum intervention technologies that are effective, that would also minimize the costs of patented procedures and products.

[PO] One criterion that is perhaps not so obvious is that the technology should not compromise people's autonomy and choice, that is, people should not be coerced into using the technology. This is particularly relevant to genetic diagnostic tests targeted at "defective genes" that discriminate against individuals or the unborn, or DNA databases that compromise people's rights to privacy. Other situations might involve nano-technological implants that cannot easily be removed by the user.

All of these criteria could be subject to debate.

We suggest, however, there are existing technologies and research areas that could be targeted for outright bans or discontinuation.

**1. Technologies that should be banned:**

- [AI] Nuclear weapons
- [AI] Biological weapons
- [AI] Chemical weapons

**2. Technologies that should be phased out:**

- [AO] Nuclear power stations
- [AO] Fossil fuel
- [AI] Antibiotics in agriculture
- [AI] Agrochemicals: chemical herbicides, pesticides, fertilizers

**3. Technologies that should be subject to international peaceful control:**

- [AO] Genetic engineering
- [AO] Nanotechnology

**4. Research that should be discontinued:**

- [AI] Any research in weapons of mass destruction, chemical and biological warfare

- [AI] Xenotransplantation
- [AI] Genetic modification of animals for agriculture, pharmaceutical and industrial productions
- [AI] Genetic modification of plants released into the environment for agriculture, pharmaceutical and industrial productions
- [AI] Terminator technologies (genetic engineering for reproductive sterility, either in seed, pollen or ovule)
- [AI] Gene therapy
- [AI] Human cloning, including “therapeutic” human cloning"

**References**


AMP 1975 = Am. Phys. Soc. Study Group: "Efficient use of energy", *Physics Today*, **23**, Aug., 23-33.
Bishop E. 1967: *Foundations of Constructive mathematics*, Mc Graw-Hill.
Drago A. 1988: "A Characterization of Newtonian Paradigm", in P.B. Scheurer, G. Debrock (eds.): *Newton's Scientific and Philosophical Legacy,* Kluwer Acad. P., 239-252.
-- 1991: *Le Due Opzioni*, La Meridiana, Molfetta BA, 1991.
-- 1994: “The modern fulfilment of Leibniz' program for a *Scientia generalis*”, in H. Breger (ed.): *VI Int. Kongress: Leibniz und Europa,* Hannover, 185-195;
-- 1996: "Mathematics and alternative theoretical physics: The method for linking them together", *Epistemologia*, **19:** 33-50.
-- 2000a: "Etica e scienza: loro fondazione comune secondo una visione pluralista", in L. Chieffi (ed.): *Bioetica*, Paravia Scriptorium, Torino 2000, 303-331.
-- 2000b: "Definizioni della bioetica e dei suoi principi", *Rivista di Teologia Morale*, n. 127, **32** (2000) 391-410.
-- 2002: "Affidarsi alla scienza? La lezione del nucleare e quella di Jonas", *Biologi Italiani*, **32**, lu. 2002, 13-21.
Esposito G. 1997: ""Teorie di principi" e "teorie costruttive" in Einstein: una reinterpretazione", P. Tucci (ed.): *Atti XVI Conv. Naz. Storia della Fisica*, (Como), Milano, 1997, 425-456).
Jarnie I. C. 2001: "Science in a Democratic Republic", *Phil. Sci.*, **68** (12), 545-564.
Kuhn T.S.: *The structure of scientific revolutions*, Chicago, Chicago U. P., 1969.
Nagler M. 1981: "Peace as a Paradigm shift", *Bull. Atomic Sci.*, **37**, Dec., pp. 49-52.
Pimbert M. P. 1994: "The Need for Another Research Paradigm", *Seedling*, Vol.**11** (2), pp. 20-26.
Prawitz D., P.-E. Melmnaas P.-E. 1968: "A Survey of some connection between classical, intuitionistic and minimal logic", in A. Schmidt, K. Schütte (eds.): *Contributions to Mathematical Logic*, North-Holland, Amsterdam, 1968, pp. 215-228.