TOWARDS A NEW INTERNATIONAL TECHNOLOGICAL ORDER?

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1. Introduction

The United Nations Conference on Science and Technology for Development (UNCSTD) is scheduled to take place in Vienna, August 1979, 16 years after the first UN Conference on "Science and Technology for Development". In a period when the flow of history seems to be running more rapidly than before, perhaps also with more eddies, waterfalls and swift currents than before, much will have happened during that period, and it is important to identify some of these trends - as they should have at least some impact on such major undertakings as UNCSTD - over and above the obvious environmental factors.

First, and most importantly: the power position of the Third World countries is quite different in 1979 from what it was in 1963. One might argue what is the reason: an increased self-confidence among Third World elites due to accumulated experience since the major decolonization breakthroughs around 1960; the basic change in terms of trade that took place for at least one commodity for at least some countries (oil) around 1973/74; the experience of having beaten the remaining western power, the United States, in Viet-Nam with the fall of Saigon April 30, 1975; or all the new expressions of some restructuring of the world economy, related to all of these phenomena, summarized under the heading of the New International Economic Order (NIEO). Whatever it is the power relations are not the same, and will never be the same again - that is, between countries and regions, not necessarily within countries.

Second, a critical awareness, a scepticism bordering on pessimism, concerning science in the west that probably was not so clearly felt in 1963. Like all phenomena it is not a clear trend, there
are ups and downs, but the general faith in science as a key to the solution of most human problems is probably undergoing a rather significant decline. At the philosophical/epistemological level this takes the form of basic criticism, at the more popular level the form of basic scepticism; the two levels interact, at least to some extent.

Third, there is a corresponding feeling about technology, particularly technology developed in the west. It has not passed unnoticed that there is more technology than ever, yet major social problems do not seem to be more tractable than before. On the contrary, there seems even to be a feeling that some of the problems of modern industrialized societies have not emerged in spite of modern technology but because of modern technology: mental diseases, cardiovascular diseases and cancer seem increasingly to be related to stress, the latter also to pollution; both stress and pollution being phenomena related to societies built on modern technologies.

The point here may not even be whether these assertions are scientifically tenable or not; they are probably increasingly believed in. Although people continue seeking the fruits and benefits of modern technology particularly in so far as it is labor saving and brings comfort, the scepticism remains: there is ambivalence rather than simple enthusiasm, no longer a honeymoon affair with modern technology. What could be called "social pathologies"—such as the changes in the disease picture, the lack of increase in life expectancy, the increasing criminality, all of them apparently having a rate of growth somewhere between 4% and 9% per year in the major industrialized countries—have not passed unnoticed although the total picture is not much spoken about. Admittedly, it could be due to other factors than modern technology but it is tempting at least to some extent to relate it to such a key force motrice.

Fourth, western industrialized countries do no longer seem to be so attractive as development models as they were in the early 60s. In one period between the two conferences this was no doubt due to the rise of China as an alternative model: not so much being a question of whether China was accepted or welcomed as simply due to the empirical existence, in China, of something different. When something different exists the
western mode of development no longer stands out as development per se, but as one out of several alternatives; like other things with positive and negative aspects. It should be remembered that westernization to many people was identical with development, based on economic growth, which again was seen as natural, in the way that body growth is seen as something that happens to the human organism as time goes on.

All this scepticism directed against the west, both in its "capitalist" or "socialist" versions, is it a carry-over from animosities against countries exercising capitalist or social imperialism, a feeling that it would be impossible to bridge the gap and really become like these models partly because they were too far ahead, partly because the methods the western countries had used were either no longer available, impossible to use or totally immoral; or is the feeling rather based on the idea that it is undesirable to realize the western models? If the latter, it may be argued that it cannot be based on much knowledge of the social pathologies of the western countries since they seem by and large to be unknown in the Third World. Nor can it be based on much knowledge or insight in the interaction between western science/technology and western development patterns, for even where there is scepticism in the Third World about western societies enthusiasm for western science and technology nevertheless seems to prevail. In other words, there seems to be some kind of cognitive detachment between science and technology on the one hand and the rest of western society on the other, combined with an idea that it might be given to the Third World to put the former to a better use without having the latter as deplorable "side effects"? A well-known technique to avoid cognitive dissonance?

The present article is directed against any such belief wherever it might exist. As such the article is in the tradition of the west raising a warning finger, putting up danger signs on the roads on which the Third World is already travelling or about to embark. And this raises the question of the politics of the warning finger. About warning fingers there are probably two hypotheses that could and should be stated immediately:
4.

(1) Although presented as being in the enlightened self-interest of the person warned the warning, when heeded, may also be very much in the interest of the warner; (2) partly for that reason, but mainly because of the paternalism involved, the warnings have a tendency not only not to be heeded, but also to be counterproductive in the sense of becoming an encouragement rather than a warning. The question is whether the present warning in connection with technology would tend to be one more item of confirmation of either or both hypotheses, and the answer will probably have to be yes, to either. Nevertheless, it is difficult not to issue such warnings, in spite of the very poor record the west has when it comes to influencing the developmental trends in the Third World.

This goes beyond relatively well known ways in which economic imperialism is operating, to the ways in which new ideas are introduced so as to serve - deliberately or not deliberately - old purposes. We are thinking of, for instance, such slogans as "Environment", "Basic Needs", "Cultural Diversity" and "Self-Reliance". All of them can be seen as foundations on which development in a very genuine sense can be built, but they can also be seen in another perspective. What they stand for, in capsule form, could be translated as follows: respect for nature, respect for the genuine needs of human beings, particularly for those most in need, respect for the fine fabric of culture, and self-reliance: developing one's own forces and factors, not at the expense of others. These are excellent principles indeed, but the Third World can with full right say that if they are so excellent, why did you people in the west never practise them? And what is the purpose in bringing them up right now, except to deter Third World countries from pursuing patterns of development that might make them strong competitors of First and Second World countries in the world market of goods, services and power? And does this not also apply to the debate about technology? No doubt there are technologies that are best for building strong states and there are technologies that are good for building strong people; usually they are not the same technologies. Why should the Third World only go in for the latter kind when the west
herself did not do so in similar phases of development? In other words, is all this talk about technology anything else than simply one more item on the list of western efforts to prevent former colonies from becoming serious competitors? 12)

We leave the dilemma at this point for there is no simple answer. The allegations against the west, e.g. hypocrisy, of not practicing what they themselves preach are true, and they do not only refer to the past, but also to the present. The people in the west who consciously practice respect for environment, for basic human needs, material and non-material, for cultural diversity (particularly among the ethnic minorities in the west) and self-reliance, to whom these four principles serve as guidelines for developing technologies, are few and marginal - at least so far. And the accusation of duplicity, of humanitarian stands with a clear non-humanitarian purpose, is one that should be taken seriously: the record of the west would point to the general accuracy of such accusations. The problem is only, however, that hypocrisy and duplicity in the western argumentation do not serve to improve the quality of western technology; the problem is still there! Hence: what are the characteristics of western technology?

2. Some characteristics of western technology.

We shall refer to the technology in question as "western", for regardless of roots that may be said to be more universal, the technologies in question have been developed mainly in the west, and spread from the west to other parts of the world with or without some modifications. By the "west", then, we refer not so much to a geographic area as to a civilizational area which it is not so important to the limit in exact terms for the present purpose. 13)

Using the very felicitous phrase developed by Amulya Reddy 14) we shall see the western technology as a carrier of a certain code, built into the structure induced by the techniques. In other words, we conceive our technology as techniques plus
structure, where the techniques have hardware components (tools) and software components (skills and knowledge) and structures are mainly of two kinds: economic and social structures on the one hand, and cognitive structures, deep-lying assumptions about reality, on the other. The assumption is simply this: whenever a technique is developed, deployed, transferred, a structure is being built, whether it is a technique for production, for distribution or for consumption. Hence, we shall use the term "technology" with the understanding that it is never "politically neutral" because it always carries a code, expressed in the structure accompanying it, social and/or cultural. Thus, a car carries a message: it says something about the size of the unit that can travel in the car with comfort, and consequently about the size of the family. It not only limits that family to a maximum around three children for most cars but also indicates the structure of the family with the parents in front and the children behind, with the father being the instrumental leader turning the wheel, the mother watching, commenting, taking care of the internal relations in the car, the boy peeping over the shoulders of the father to learn the tricks, the daughter sitting behind the mother doing likewise. And a car is an expression of a certain attitude to other human beings (regulated competition) and to nature (depleting and polluting nature but running away quickly from the scene).

Without going into details let us simply split the code into three parts: economic, social and cultural. The economic code can be expressed in terms of factors, and the formula would be that western technology tends to be capital-intensive, labor-extensive, research-intensive and organization-intensive. As to nature, it is difficult to have any clear view: modern electronic industry, for instance, is not necessarily very demanding in terms of "nature", meaning raw materials for directly material or energetic purposes. However, economistic reasoning in terms of abstract factors does not carry us very far. Often it makes much more sense to say "capitalist-intensive", "researcher-intensive", "manager-intensive" and "worker-extensive", in other words, referring to concrete persons rather than to "factors". Putting it this way one may see more
clearly what western technology has been about: laying the basis for a mode of production that would call increasingly on the skills of capitalists (the specialists in financial matters), researchers (the specialists on general laws in the sense of predictions), and managers/bureaucrats/administrators (the specialists on general laws in the sense of prescriptions) than on workers. Still put in another way: western technology is leaning increasingly heavily on social elites, less on the industrial proletariat; it may even be seen as a way in which that industrial proletariat can be eliminated. One way in which this shows up is, of course, in the famous increase of the tertiary sector and decrease of the secondary sector where employment structure is concerned, in western societies. Still another way of saying this would be to point out that western technology can only be put to use where there is a sufficient concentration of capital/capitalists, research/researchers and organization/managers - and this would in general be in the capital of the country. Given the scarcity of these factors and the necessity of concentrating them in a relatively low number of spots, the injection of western technology will tend to increase tremendously the existing inequalities.

Then, the social code. The term very often used in this connection is that western technology is "dependency forming." This is no doubt correct: once the technology has been implanted an everlasting demand structure is created for spare parts, for more knowledge and skills, for new technologies. This is important, well known and obvious; it is also obvious that the same pattern is replicated as in a system of Chinese boxes within countries, in general between center and periphery. But it should be pointed out that the notion of "verticality" as the general aspect of the structures accompanying western techniques, built into the technologies, goes much further and is much richer. It is not only that the command positions are retained by the center for their material and non-material enrichment, e.g. for the accumulation of profits by selling the work product of scientists and technicians as commodities (the price paid being referred to as fees, under the headings of patterns, licences etc.) and by reserving the most important
and innovating tasks for the center because of the virtual center monopoly on the means of intellectual production. It is also that by doing so the center is conditioning the periphery, impressing its tastes on them, defining what products are worth producing and consuming (i.e. the products that it is possible to produce with the techniques given), the conditioning in the opposite direction being a very minor one indeed. In doing all of this the center constitutes an inner core marginalizing the rest, turning them into "factors of production", and clients who perform the roles as consumers. It is also worth noting that western techniques of production and consumption tend to be fragmenting in the sense that they can be carried out without much interaction or mutual help among producers and consumers. Of course, workers in a factory are tied together with the visible and invisible ties of that particular form of organization, but they are not necessarily in direct interaction depending on each other. And the same applies to consumption: two persons watching TV are tied together by that medium, but they are not necessarily watching together in the sense of interacting. And western technology tends to be segmenting: people participate in it with only a small part of their personality, often referred to as specialization or compartmentalization. In other words, western technology tends to drive wedges between and within people. All of this is very often written about and commented on, the point is that there is a total picture to it, a total pattern which on other occasions I have referred to as the alpha-structure. The thesis is that it is built into western technology.

Again, it may be objected that this type of analysis is too structuralistic and that it should be accompanied by an analysis in more concrete terms. Thus, who are the concrete people who are in the center of this structure, who are on the periphery? By and large it seems to be fair to say that they are the same people that were pointed to in the preceding analysis of the economic code carried by western technology: the specialists on finance, research and administration. In general terms these are key categories in what is loosely referred to as the "tertiary sector", on the upper rungs of the social ladder.
inside that sector. And the basic point in this approach to technology can now be formulated: it is not that technology by chance happens to induce structures of this type, it is rather that the structure produces, filters out and accepts only the techniques that will be accompanied by such structures, thereby reinforcing the structures themselves. Any technology that demands less in terms of finance, research and administration will constitute a threat to specific groups of people, and if in addition it is more horizontal in the sense of inducing less difference between center and periphery, is less conditioning of the periphery, less marginalizing, fragmenting and segmenting, then the general power of the center over the periphery will be reduced.

Today it looks as if China is an important case for those who want to study the structural aspects of technologies. If there is anything the Cultural Revolution was about then it was exactly to build production patterns that would be less vertical. The people's communes were a particularly important instrument in this connection; less dependent on finance, on research and administration and used techniques that could be more integrative, induce more togetherness, more general participation, more mutual conditioning and indeed more equity within and between communes, and units inside the communes. But this could not possibly take place except at the expense of the power of certain groups: the state capitalists (the private capitalists having been eliminated as a class at an earlier stage), the researchers/professionals/intellectuals, the bureaucrats - and to this one might then add the top military people and the top party people as two particular elites closely related to the other three. It can be guessed that the five elites did not like to see their power basis eroded, regardless of whether this was done with or without much violence, with or without much personal humiliation (probably without much violence but with much personal humiliation). As far as one can judge they did not wait long after the death of Mao Tse-tung before they hit back, and the rest of the story during the two years that have passed since his death is to a large extent the story of basic technological change, meaning (re-)introduction of techniques that can more properly be described as western
in the sense of inducing the particular economic and social profiles referred to so far. In other words, the struggle, indeed fight, about which technology to use is essentially a political struggle about power, about the steepness of the center-periphery-gradient of the society, about who shall be in the center and who in the periphery.\textsuperscript{20}

To this could then be added the cultural or civilizational codes; the idea that built into the technology is also a certain cosmology, an implicit way of viewing the world in general and society in particular. This is not the place to go into detail\textsuperscript{21} suffice it only to mention that there seem to be five components of western cosmology of some significance: the tendency to see the geographical space in center-periphery-terms with the center in the west, the tendency to see time as linked with ideas of progress, with something becoming better, more, increasing at least in a linear, preferably in an exponential manner; the tendency to think of reality in terms of units abstracted from the whole of which they are parts and related to each other causally and mechanically so that changes in one will imply changes in the other; a tendency to see vertical and individualistic relations between human beings as normal and natural; and a tendency to see man as the master of nature with unlimited rights as equally normal and natural. The point here is that these are not necessarily formulated explicitly as manifest ideologies; they are deep ideologies constituting a basis for defining something as normal and natural and something else as abnormal and unnatural. Western technologies fall in the first category to the extent that they are compatible with such assumptions; in other words to the extent that there is dependency on a western center, that they do produce more and more, that they are based on analytic rather than holistic insight, that they do induce man over man and man over nature relations. Technologies that fall short on these points or even are the exact opposites would be seen as strange, quaint, "romantic" (a very important term in the vocabularies of those who defend western technologies) and tend to be rejected.\textsuperscript{22}
Thus, the total picture is one of transfer of technology as a structural and cultural invasion; possibly of much larger significance than colonialism and neo-colonialism, precisely because it is not necessarily accompanied by any physical personal western presence, not even in the form of elites with allegiance to the west. On the contrary, it is entirely compatible with elites that reject the west in all regards except for the technology - as mentioned in the introduction this somewhat inconsistent attitude is not only possible but may even be prevalent. Add to this, then, the environmental factor: the accusation against western technology that it tends both to pollute and to deplete non-renewable resources, not to mention that it also tends to have deeper impact on the level of maturity of eco-systems, both at micro- and macro-levels.

How is it possible not to see all of this? One reason is very simple: it belongs to the fragmentation induced by western technology that visions of western technology also tend to be fragmented: there are those who emphasize environmental aspects, those who look at economic factors and particularly at the capital costs, those who look at social factors, and those who are concerned with compatibilities or incompatibilities between western technology and endogenous cultures. Only very rarely are these factors put together so as to constitute a more general picture - as attempted in the preceding pages. But even if such images became more prevalent they would not constitute a sufficient basis for mobilization against western technology; it would lead to consciousness-formation, but not necessarily to political action.

The reason for this is that there is a second factor at work: the argument that even if everything said so far is true it is not the total picture. There are also good things to say about western technology. More particularly, if that were not true, and one assumes that western people are not all of them fools or masochists, then westerners would themselves have given up that technology! In short, there must be something to it since it is so vigorously adhered to, in spite of all the noises emanating from the citadels of the west to the effect
that it isn't all that good, like the millionaire telling the
destitute "money is not everything in this world" or the over-
educated double Ph.D. telling the illiterate "believe me, I am
sure you are the wiser person than I am". So, what about that argument?

3. Will western technology have the same positive effects
in the Third World as in the west?

The position taken in this paper is certainly not that western
technology is all bad nor that it cannot also bring blessings
to the Third World, and indeed already to some extent has done
so. Thus, there are highly capital intensive projects that
perhaps, when properly evaluated, can be said to have rather
positive effects. One example in mind might be communication and
transportation facilities between peripheral points in a Third
World country (or in any country for that matter). Excellent
transportation/communication facilities between the capital
and the periphery have more mixed consequences; they tend
to be the media through which more control and potentially also
more exploitation may be exercised by the center of the peri-
iphery. There are health schemes, perhaps particularly in the
field of preventive medicine, that are based both on capital,
research and organization having as a consequence that the life
expectancy at the age of four is not too different as between
developed and developing countries.25)

Labor saving devices can eliminate excessively heavy, dirty,
degrading and monotonous work - but the monotony is then pro-
bably reintroduced by the way industrialized modes of production
tend to organize work. In general terms, western technology
also provides comfort, meaning by that a kind of protection
of the human body and psyche against less pleasant aspects
of nature. The argument that this has led to overdevelopment
in western countries, at least for some segments of the popu-
lation, among other reasons because of over-protection from
heavy work (including the type of "heavy work" referred to as
walking), and a distance from nature that must in some way
or another make us more vulnerable, does not carry much weight.
It can be argued that there is an interval between the under-
development of most Third World countries and the overdevelopment in some parts of western countries, making the problem a moot one (except for certain elites, usually located in Third World capitals where the same phenomena may already be present).

Much more important, however, is a different argument the implications of which are not yet clear because history has not yet moved that far. It is generally assumed today that much of the living standard in the First World is at the expense of the Third World; or in more particular terms that it has been possible in the First World to obtain a much higher level of equality because of export of the periphery to the Third World. Today this takes the concrete form of export of jobs to Third World workers, thereby cutting labor costs with something like 90%. Patterns of exploitation no longer possible inside First World countries are possible at Third World level, but they require a new international division of labor.

To repeat this trick with a technology that is inherently periphery forming the Third World would have to have a fourth world to exploit. It may be said that this is being done by Third World elites in the capitals using the rest of the countries as the fourth world, which then raises the question who they are supposed to exploit. Answer: nobody, as there is no extra fifth world around; the process runs out of worlds (unless some celestial body is discovered).

Second, although the material conditions of workers in the Third World may not be that different from the material conditions of the First World workers as described by Marx in the last century there are some important differences. Technology has "progressed" further, the transition from electro-mechanical to electronic industry makes the vertical division of labor, the conditioning, the marginalization, the fragmentation and segmentation even more pronounced — reducing the worker even more to a robot. And this raises the question whether the worker will not soon be replaced by robots simply because they
are less troublesome and pay better returns? Also, it should be remembered that the food basis for Third World workers, the countryside, is also being increasingly exposed to the same type of industrialization process, producing commodities for First World markets rather than goods for subsistence.

Let us try to reformulate these arguments. Western technology is in and by itself periphery-forming, in many ways. It does deliver goods and services, an astounding variety of them, but at a cost - it is hard on people, hard on nature. The techniques always induce externalities: by and large positive for the center particularly in terms of the creativity demanded from the few, and by and large negative for the periphery, because of the sacrifices demanded from the many, and from nature. To the general western way of trying to run the world this is natural/normal; the world is or should be like that. Colonialism was one expression of it, capitalism another, western technology still another. To internalize the positive and externalize the negative externalities is roughly speaking what the system is about. From pushing the negative externalities on their own masses the western centers seem to be increasingly successful in pushing them onto the Third World. By and large the Third world elites are cooperative.

The whole point we are now trying to make is that this does not change if the same technologies are put to use inside the Third World. There will still be externalities highly unequally distributed. As it is rather unlikely that the First World will accept the negative externalities by doing jobs for the Third World contributing only raw nature and underpaid workers, being at the periphery end of it all and in addition committing cultural suicide, other Third World countries, and the masses and the nature of all of them, will have to carry the burden. Because of the built-in structure the technology itself will force the stronger Third World countries to start exploiting the weaker ones and the elites to exploit the masses and to overtax nature, for this is the condition for that technology to be operative. And then the argument is not that this is a possibility it is already happening. The argument is (1) it will not help the masses in these countries, (2) those masses cannot be exploited further and (3) we are at the end of the road, beyond where we are now there is nobody left to exploit. The situation is qualitatively different. Hence it calls for a qualitatively different approach.
4. Some criteria for the selection of technologies.

Given the type of critique of Western technology presented above, what would be the criteria that could and should be used in order to improve on, or completely avoid the more deleterious aspects of that technology? What would be the questions that should be asked of any technology, the guidelines that should steer the work of scientists and technicians concerned with real development? One such proposal is presented in Table 1 (see next page).

In the list of criteria or considerations proposed in this Table, the broad headings "economic", "social" and "environmental" are used, subdivided into six criteria with each one, in turn, subdivided into two — yielding a total of twelve. It is in the nature of such lists that they may generate more controversy than consensus, potentially leading to a fruitful process of adding to, subtracting from and modifying the items — a process which in and by itself is a part of the consciousness-formation. The present list may derive its rationale from current thinking and practice in the field of eco-development, where development is seen as "development of human beings, not of things," interpreted as the satisfaction of material and non-material needs; and the "eco-" stands not only for counteracting depletion and pollution, but for building a stronger environment. These are broad criteria which have to be taken into account in arriving at decisions not only dealing with the selection of technologies but also with the processes that generate these technologies. It needs to be emphasized that the weights assigned to each criterion or combination of criteria will have to be determined in each individual case with as wide a participation as possible of persons directly involved in implementing them or being affected by their implementation.

The purpose of laying down criteria for the selection and development of technologies is to broaden the base for decision-making in this field, so crucial for any progress in the field of eco-development. The relative weight given to these criteria will vary from place to place and over time, but in making the criteria explicit at least some consideration will have to be given to any one of them, if they are adopted. There is a very important qualitative difference between, say, ignoring completely the extent to which a technology is self-reliance building and taking it into consideration, but giving it low weight; or giving it high weight, but conceding that the technology chosen does not meet the criterion. In the first case the decision-making agenda remains closed in that direction; in the latter cases the item is at least on the agenda, forcing a consideration of the issue. In so doing the criteria may
| (1) **BASIC NEEDS SATISFACTION** | does it directly or indirectly (over short time) contribute to the satisfaction of such basic needs as food, clothes, shelter, health, education, transportation/communication? does it produce goods and/or services accessible to those most in need? |
| (2) **FACTOR DEVELOPMENT** | does it use local factors optimally over time? generating employment; developing medium and high level skills and engineering and R and D capabilities and using them for the purposes of further technological development; saving/generating capital; saving/generating raw materials including energy; generating more appropriate technologies; does it increase the capacity to produce on a sustained, cumulative basis over time? |
| (3) **STRUCTURAL DEVELOPMENT** | does it reduce dependence and promote self-reliance (autonomy combined with selective exchange on an equitable and solidarity basis and with mass participation) at the local/national/regional levels, enabling the society to follow its own path of development? does it reduce inequalities? between occupational, ethnic, sex and age groups; between rural and urban communities, and between (groups of) countries, especially in the field of scientific and technological capabilities; |
| (4) **CULTURAL COMPATIBILITY** | does it make use of and build on endogenous technical traditions? does it blend with/enhance valuable elements and patterns in the local/national/regional culture? |
| (5) **HUMAN ENRICHMENT** | does it lead to creative involvement on a mass basis by being accessible, comprehensible and flexible? does it liberate human beings from boring, degrading, excessively heavy or dirty work? |
| (6) **ECOLOGICAL BALANCE BUILDING** | does it minimize depletion and pollution by using renewable resources, through built-in waste minimization, recycling and/or reuse and blending better with existing eco-cycles? does it improve material and man-made environment by providing for a higher level of complexity or diversity of the eco-system, achieving balance and reducing the vulnerability of ecological systems? |
potentially serve to increase the level of joint economic/social/environmental consciousness, and not only among policy-makers, but also in scientists, engineers and technicians, and above all in the population at large. There is a general need for increased technological consciousness in the population of most countries so as to generate demands on those who deliver the technologies including popular inventiveness itself; making them accountable in terms of such criteria.

An adequate generellay agreed upon methodology of selection, based on criteria such as these, does not exist today. One reason for this may be that excessive specialization and professionalization have led to such diverse approaches in economic, social and environmental sciences that we do not even possess a common language adequate for comparisons across disciplinary borders, leaving alone a common unit of measurement. Without prejudging future there is the need for a general development in these disciplines, or the growth of transdisciplinary approaches, warning against any methodology that would tend to exclude criteria that have not yet been quantified, possibly even because they are intrinsically non-quantifiable (which may be particularly true for some of the social criteria). Whatever can be quantified should be quantified; for whatever cannot "rules of thumb" can often be developed - e.g., the judgement of a qualified group of those affected one way or the other by the decision as to whether the technology is "positive", "indifferent/unclear" or "negative" in its consequences along that particular dimension. Whether quantitative or qualitative the net outcome of such considerations would be a profile for any given technology, and it is this profile or configuration in toto that has to be evaluated. The bias should be in favor of simultaneous rather than sequential evaluation of the profile last sequential decision-making might (1) knock out already in the first filtering process technologies that when viewed in their totality might have highly redeeming characteristics and (2) play up to narrow specialization, disciplinary or otherwise, instead of fostering the type of broad overview and approach that simultaneous evaluation would tend to foster. In that evaluation there would still be room for making a criterion an absolute condition (in the sense that if it is not met the technology in question is out) - but only after giving the technology a chance by looking at the total profile.
Criteria such as these should not be interpreted in a passive, static way as yardsticks used for the selection of existing technologies (from a set of alternatives), but in an active, dynamic way, as a heuristic leading to the development of new technologies. Few technologies today will meet all criteria, but this should lead to a quest for ever more appropriate and environmentally sound technologies, and not merely for a trade-off between criteria. Since the social and environmental criteria are the ones that have received least attention so far the concrete consequence of adopting such lists of criteria as general guidelines will probably be more in the field of generating new technologies than in evaluating already existing ones, provided they are used in a constructive, not only in a critical spirit, opening for new sources of inspiration in technological innovation.

Even given a much higher level of consciousness and inventiveness, including popular participation, it is obvious that there will always be technologies not meeting all criteria. More particularly, the criteria relating to local self-reliance, human enrichment and cultural compatibility may often best be met by technologies related to relatively small scale industries and more limited economic cycles. In such settings environmental criteria may also often more easily be satisfied. Many of the economic criteria may possibly be best met by technologies associated with large-scale industries and extended economic cycles, sometimes operating at the national, sometimes at the regional, sometimes even at the global levels. Hence, the criteria should be seen as a guide for a better mix of more appropriate technologies operating at the various levels, in different and in the same sectors of goods and services (e.g., in the fields of food-production, or medical care). In some countries this should lead to a strengthening of technologies at the local level, in other places to a strengthening of other levels, that it does not mean, however, is any all-out rejection of "western" technology or acceptance of "traditional" technologies. The criteria should be used constructively so as to modify and develop further "western" and "traditional" technologies alike, in addition to generating new technologies that cannot be placed in either category. In doing so it will probably be recognized that the unit of selection and modification/development is not only the technology itself, narrowly conceived of with its hardware and software components, but the total structure and process related to it. Consequently the selection process will be part of a general social dialogue that is part and parcel of human liberation processes.
While in no sense extolling one-sidedly the virtues of the local and the shortcomings of higher levels of production/consumption, the trust of the total approach, in many countries, would be to strengthen the local level. Predictably this will lead to resistance from groups with vested interest in higher levels, not only those engaged in centralized decision-making and resource-control (including the control over capital); but also scientists, and researchers in general. Science tends to be universalist searching for general solutions; central administration tends to look for nationally standardized solutions; and capitalistically run enterprises tend to be both expanding and centralizing - leading to considerable harmony of interest between these three groups, not only at the national, but also at the regional and global levels (including inter-governmental agencies). Modes of retraining and redirecting scientific research - to mention but one of the groups - to make it more relevant for and sensitive to the local level and local participation would therefore be an important ingredient in an action program devoted to the objective expressed in the criteria, blending scientists and villagers in ways unknown today.

5. Some proposals for joint action

Given this kind of situation, where on the one hand there is a well developed technology with many built-in dangers and on the other hand there is a quite explicit list of wishes, desiderata, but not many technologies that meet them, what can be done? And more particularly, what can be done in a joint co-operative manner, involving both "north" and "south", both the First, Second, and Third Worlds - preferably in a multilateral, even a UN setting? The following are five broadly phrased proposals in that direction.

First, the basis for technology assessment should be broadened, including in addition to economic and environmental criteria more explicitly also social and cultural dimensions. Assessments should be made public, even including warnings. If it is possible to reduce smoking, at least among middle aged males in industrialized countries, by means of a campaign where pro-
spective buyers of tobacco products are warned that they may be "dangerous to your health", it should also be possible to reduce some of the abuses of careless technologies by issuing warnings to the effect that they may be dangerous to individual as well as social "health". It would be interesting to see what joint north-south-commissions working on such problems might arrive at, although it is quite clear from past experience that the problem here is not whether the composition is international but whether the composition is sufficiently interdisciplinary, whether it includes a sufficient number of perspectives on technology, and perhaps also whether it includes people who are not intellectuals and for that reason do not have our déformation professionelle.

Second, there is the task of developing together technologies that better meet the requirements, for instance as listed in Table 1. In doing so there should be a very good basis for north-south co-operation on an equal footing: the south could contribute with deep insight into traditional technology, the north with much of what has been developed recently and is still very quickly developing in the field of alternative technology. Often they are similar, often they are different. Thus, an economic profile that might be interesting would be the type of technologies that are nature-extensive, capital-extensive, labor-intensive, research-intensive and organization-extensive. In other words, the major inputs would be labor and research, work and ingenuity. It may well be that recent advances in new ways of producing foodstuffs, based on a much broader utilization of natural eco-systems, would fall into this category. It may be objected that the research would probably be carried out in the north and the work in the south; the problem would be to find ways of transcending that type of contradiction. One place where this has probably been done might be in communes established on northern Europe, typically staffed by highly educated intellectuals with considerable research training and skills, but also very willing to carry out manual work. In short, another example of how structures may produce techniques if the consciousness and the political will are present; when these two important factors are not present, the techniques will induce structures and human beings will be conditioned
by those structures.

Third, to develop a new mix of different types of technologies, whether they are referred to as western/non-western, alpha/beta or whatever. This is very much a field in search of not only practice but also in search of theory. How much and what should be given to western technology to produce, how much and what to other types? Again, this constitutes a field where north-south co-operation could be on an equal footing. As long as that "co-operation" is about conditions of transfer of western technology it is obvious who has the upper hand. But the political wish for more equitable relations north-south is an expression of structure, that structure should itself serve to direct the composition of that mix so that more equal relations can be obtained. For this to happen much political skill is needed, and it will not be easy to produce the necessary willingness to let the opponents of "modern" technology in the north, and in the south as well, have as much of a say as the very vociferous proponents.

Fourth, the possibility of more transfer of technology the other way, from south to north. The argument would not in general be in terms of transfer of traditional technology in the south: it would probably usually be as unsuited to the north as western technology is to the south — according to the analysis in section 3 above. The only condition under which that type of transfer would be possible would be the reverse of the condition that has obtained in the world: 500 years of domination exercised by the south over the north, preparing the ground. This condition not obtaining, what would be of interest today would be much more openness in the north to consider new ways of developing "mixes". Thus, one interesting example is how a country that one century ago would have been classified as belonging to the "Third World", Japan, was somehow able to build a buffer around western technology, encasing it in a social structure somewhat different from the western one. Today there is technical co-operation from north to south, the beginning of technical co-operation between south and south (TCDC); it is high time that some patterns of technical co-operation from south to north should emerge.
Fifth, what about a possibility of other channels of transfer of technology, or dialogue about technology than the channels most prevalent today? When we say transfer "from north to south" even that is actually a non-valid metaphor: in fact it is a transfer from certain groups in the cities of the north to certain groups in the cities of the south. It is urban-urban-co-operation, which leads one to ask the question what rural-rural-co-operation might look like. How would it be if more direct dialogue and co-operation were possible between rural communities, for instance communities that try to become more self-reliant whether they are located in southern Tanzania or northern Norway today they may articulate demands, or needs maybe imposed upon them; but the channel through which dialogue and possible co-operation takes place would be fora for negotiating elites drawn mainly from the two capitals concerned, in bilateral or multi-lateral settings. Needless to say, the world communication structure is made in such a way as to steer co-operation that way, and away from those that potentially might benefit most from direct contact.

6. Conclusion

The general thesis of this paper can now be stated in one sentence: techniques are accompanied by structures, these structures eventually decide which techniques will be seriously researched, developed and deployed. The structures steer the techniques once they have become sufficiently well rooted. Techniques that induce very different structures will tend to be rejected, left undeveloped, or marginalized as something to be indulged in by small, peripheral groups. For these techniques to come to the forefront and dominate the social picture more a highly conscious attitude to the interplay between techniques and structures is needed, and a political will to change the structure and to use alternative techniques as one instrument in this structural change will have to be present. That political will is not easily mobilized when everything seems to proceed relatively smoothly. More particularly, it is not mobilized when the negative effects of the technologies can by and large be pushed onto others, even onto other countries,
other regions.

From this it would follow that it is mainly during crises that a major change of techniques will take place; in other words when the dominant structure is sufficiently weak. Thus, there has probably never been such a lively debate about alternative technologies in the west as during the oil crisis. If that type of crisis situation were to return it is likely that the movement towards alternative technologies will be given even further momentum, not only in terms of new technical innovations, but also in terms of social practice. And thus, we may very well end up with the following situation: as the crisis broadens and deepens in the west the search for alternative technologies and for better mixes will be intensified; possibly leading to much more felicitous combinations in the west. And at the same time the wave of western technology will have continued unabated into the Third World, enriching the few and impoverishing the many, materially as well as non-materi ally. So once more the west may end up with the better part of the deal ---.

To avoid this there is only one course of action that bears some promise for the future: that the West itself starts assessing its own technology in more mature ways and starts drawing conclusions in action terms for this evaluation. If the conclusion of all of this is in the direction that somehow Gandhian technologies are better, more human, than the typical Western approach, well, then it is good for all of us, not only for the masses in India. If appropriate technology is to be an export product foisted on the masses of the Third world by First world elites so that the latter can continue plundering Third world lands, then it is wrong. If it is something that the First world also wants to start practising simply because it is better, using its ingenuity to develop new technological mixes, less harmful to human beings and to nature, at home and in other countries, then that may convince more than any declaration, papers or books will ever do. And fortunately, there are some moves in that direction - the situation is not entirely dark.

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NOTES


1. The importance of listing the major discontinuities in thinking and practice between the two conferences was conveyed to me by Professor E. Maraghi, Tehran - but his and my lists differ somewhat.

2. For an analysis of the likely impact of the New International Economic Order, see Johan Galtung, "Poor Countries versus Rich; Poor People versus Rich: Whom will NIEO Benefit?", in Self-Reliance and Global Interdependence, Ottawa, CIDA, 1978 (also available as Papers, No. 62, from the Chair in Conflict and Peace Research, University of Oslo).

3. A barometer here might be the tendency to enrol in colleges of engineering and natural science faculties. From a down in the early 70s there was an upward trend that then seems to have flattened out, perhaps even with a new decline. The time period considered is much too short, however, to arrive at any conclusions.

4. See Ornauer, Slocinski, Wiberg, Galtung, eds., Images of the World in the Year 2000, Mouton, 1976 for analyses of the deep pessimism with regard to science in the more "developed" regions of Europe, relative to the science optimism encountered in the less developed parts and in the Indian sample in that ten nation study.


7. This, however, is only possible if a sufficiently broad definition of "technology" is made use of, not restricting the concept to tools, skills and know-how, but also including the structure - between countries and regions, within countries, and between people - needed for a technology, of production or of consumption, to be operative.
It may be argued that this is a trick: to relate techniques to social pathologies an intervening variable is interspersed; social and cognitive structure. But how can techniques operate except through the medium of social structures, and how can the knowledge be developed and imparted without a cognitive matrix capable of embedding that particular type of knowledge? Moreover, given these structures the thesis also runs the other way: the structures serve as filters in the sense that only those techniques that are compatible with the structures will be accepted as serious candidates for socially relevant research and development—the ones that run counter to the dominant structures will at best remain marginal as something for peripheral groups, at worst be eliminated as archaic, or even as dangerous. These points are discussed in some detail in chapter 2 of the book referred to in footnote 5 above. Also see Persson, B. and de Monthoux P.G., Filters—Limits to Technological Choice.

8. For an effort to spell out the Chinese development model in structural and cultural terms, for the period 1966-76, see Johan Galtung and Fumiko Nishimura, Learning From the Chinese People, Georgi, 1979.

9. In a sense this is an outcome of the Western ability to propagate its particular form of science and technology as universal rather than qualifying them with the civilizational/cultural/ethnic term "Western" or some equivalent. As a matter of fact, the "qualifying" adjective most used in the West is probably "modern", which together with the implicit and explicit universalism well expresses Western arrogance in these matters. But it facilitates cognitive dissonance resolution by permitting non-Westerners to be against the West for any number of reasons, yet be positive to S&T. In doing so much will be done to identify non-Western parallel development or contributions to the Western mainstream, thereby underpinning the thesis of universalism, trying to make it look more symmetric. Of course, there is no clear cut dividing Western and non-Western technologies in geographical terms; the thesis can only be that Western technology is predominantly a carrier of the code described in section 2 of the paper, and that there are other technologies in this world. Curiously enough the lack of analysis of the structural aspects of technologies also applies to marxist thinking in this field—contrary to what one should have imagined, viz., that marxism more than any other orientation would sensitize analysts to the relation between techniques and structure, between means and modes of production. Thus, in a paper "Social Side-Effects of the Introduction of New Technologies", VIIIth World Congress of Sociology, Toronto
August 1974, Alexander Szalai of the Karl Marx University of Economic Sciences in Budapest comes close to seeing the obvious, that "modern" technologies do reinforce class differences, without saying so:

"As a consequence of the up-to-date conditions of production and the inordinately costly investment in new high-capacity productive equipment it became necessary to introduce two- or three-shift and even continuous utilization of the work force (day and night turns comprising even week-ends). This was often extended to fairly great masses of workers without having previously considered and analysed what kind of changes should have been brought about in the various social institutions and services-- (italics ours), p.13).

What kind of changes? He mentioned "whether workers' homes had adequate shutters, blinds, curtains to darken the bedroom in the daytime" (p.14). So, "it became necessary"? For whom? To use the technology as an excuse when "there are problems arising from the fact that husband and wife are working different shifts"? (p.14). A good example of the shallowness of the characterization of Hungary as "socialist" when such aspects appear as side-effects, and even as surprise-effects! If technological policies were in the hands of workers and not in the hands of bureaucrats/intellectuals, and these workers had been given the opportunity to develop their consciousness about such matters they would have been given top consideration. It is also interesting that solutions are in terms of shutters, blinds and curtains -- in other words, the technology is not challenged, only the "side-effects" are attempted muffled.

10. And this is, of course, particularly true if the Warner himself does not practice his own warning but never seems to tire of the S&T he warns against. Deeds probably communicate warnings better than words.

11. Both the International Foundation for Development Alternatives in Nyon, Switzerland and the Goals, Processes and Indicators of Development Project of the United Nations University are built around such themes; all of them also embedded in the Cocoyoc Declaration of 1974. (For one presentation of the text of that declaration, probably about ten years ahead of its time, see Development Dialogue, 1975.

12. And the point can be driven further: by insisting on modesty and frugality in various ways for the Third world it also becomes easier for the First world to continue abusing the resources of the Third world, growing raw materials for its own industry on
Third world soil, cutting down the forests, mining mountains and oceans for resources, etc.


14. See his article in CERES.

15. For details see the book referred to in footnote 5 above, ch. 1.

16. It should be noted that statistics dividing the "active population" according to primary, secondary and tertiary sectors show increase in almost all countries in recent years; but even more so in the first world countries. Moreover, since the tertiary sector covers anything from the shoeshine boy to the head of state, passing through the bureaucrats, capitalists and researchers it is a mixed bag indeed, comprising both "service" and "serviced" sectors.

17. See footnote 15.

18. In an excellent article, "L'industrialisation: imitation ou innovation", Revue 2000, No. 34, 1976, pp. 33-38, Daniel Thery gives eight examples of alternative technologies, among them such examples as biogas the bamboo tubewell and imaginative uses of bicycles. For all of them there are indications of local creativity the moment there no longer was dependency local bureaucrats, capitalists and/or researchers, "-- ces faits démentent les thèses communément répandues sur l'inertie des petits fermiers et leur résistance au progrès technique" (p.36). What is quite clear as to resistance, however, is how exactly these elites resist such initiatives. Or take another example: Cain, Afshar, Norton and Mohammed-Reza Daraie point out in their article "Traditional Cooling Systems in the Third World", The Ecologist, Vol. 6 no. 2, pp. 60-64 how effective ancient cooling systems such as the porous water-jar (the Mazira) are, keeping water cool throughout the day even when the outside temperature fluctuates between 19°C and 36°C. But what gains would there be for these three categories with a system as simple as that? Or for the oil companies who ultimately make profit on producing the electricity that is used in mechanical refrigeration?

19. For more details, see the book referred to in footnote 8 above, last chapter, "China After Mao".

20. The blindness of one particular social science, "economics", to such aspects of production, distribution and consumption should make
one venture the hypothesis that the major social function of that science is exactly to mask the real relationships between people. Marxism did much to lift that veil but not enough: there was and is far too much concentration on ownership patterns, a very special and juridical (as Marx himself points out) aspect. There is not enough about exactly what should be the strong point in Marxist analysis: the relation, often contradictory, between means and modes of production (Marxism, incidentally, also has relatively little to say about consumption). In a sense marxists are worse off than others for they may be led to believe that a change in ownership patterns is not only a necessary but also a sufficient condition for more basic changes to take place.


22. The debate over energy forms for the future after the Western robbery of the Middle East is coming towards an end is a good example here. From a B, C and I point of view (the three elites mentioned) nuclear energy systems stand out as ideal: they are impossible without a highlevel supply of heavy bureaucracy, capital and research. However, it cannot be presented that way; the decision to build the future around nuclear energy has to come as a "rational" decision. One way of arriving at a foregone conclusion is as follows: by a biased choice of competing systems (eg., only coal), and by a limited spectrum of criteria (eg. limited criteria of economic efficiency, including ecological considerations).

23. And these are the elites that will meet late August 1979 in Vienna for the UNCSTD. Volker Rittberger discusses UN conferences in an excellent paper for the Lund Seminar; "The New International Order and United Nations Conference Politics: Science and Technology for Development as an Issue Area". No doubt UN conferences can serve to articulate problems, but our simple thesis will be that it can only articulate those problems over which there is sufficient dissent in the conference room itself. In connection with UNCSTD, roughly speaking a conference of national delegations, ie. elites interested in preserving internal power structures cemented by the technological structures referred to, there will be articulation about terms of transfer, not about the nature of that which is transferred. For a remarkable
effort to overcome this problem and build more genuine articulation into the UNCSTD exercise, see the series of The Lund Letter on Science, Technology and Basic Human Needs (Notes on Preparations for the 1979 United Nations Conference on Science and Technology for Development), starting with no. 1 July 1977 (issued about every three months). Together with the document by Stefan Dedijer, The Failure of the 1978 UN Conference on Science, Technology and Development, Off- print Series No. 2, Research Policy Program, University of Lund they give us one side of the sociology of a conference. The UNCSTD side, one would assume, is that of a vain secretariat, unable to accept that type of criticism and advice, trying to fend it off by characterizing the critics as marginal. And yet it is probably safe to assume that future historians of UNCSTD and similar efforts will say "if they had only managed to overcome hurt vanity and had paid more attention to such critics".


25. The difference between the life expectancies at birth, $E_0$, is of course high, as known from the general development literature. The infants and small children are the major victims of underdevelopment in that sense; of course, they do not have much of a voice of protest.


27. There are, of course, two major methods: the import of foreign workers to carry out menial jobs no longer wanted by local workers (e.g., garbage collection), and the export of jobs to places where workers are more available for such jobs/less mobilized politically/willing to accept much lower wages.

28. Kreye et al. make this one of the key conditions for the new international division of labor, the other one being the lower transportation costs making it economical to produce far away from the markets (although a local market close to the production site is no objection)

29. The countries to watch would be the Third world countries capable of investing abroad, such as Mexico, Brasil, Nigeria, Saudi Arabia, Iran, India and the four mini-Japans: South Korea, Taiwan, Hong Kong and Singapore. At this point the sub-imperialist model is probably no longer so applicable - these countries may start exploiting other
Third world countries not on behalf of the classical imperial countries (the US, the UK, Japan etc.) but on behalf of themselves, although probably not if it is at odds with the interests of the "mother" countries.

30. This section is based on a presentation made at a UNEP seminar on selection of technology, Nairobi, September 1976. I am indebted to other participants in the seminar, and particularly to Amulya Reddy, its able chairman, and to Surendra Patel of the UNCTAD Division for Transfer of Technology.

31. For a good introduction to the topic of ecodevelopment, in English, see the special issue on Ecodevelopment, edited by Bernhard Glaeser, of Vierteljahresberichte, Probleme der Entwicklungsländer, No. 70, 1977 from the Forschungsinstitut der Friedrich-Ebert Stiftung.

32. For an effort to explore ethical problems confronting any scientist from a point of view of basic needs, see Johan Galtung, "Science and Neo-colonialism", chapter 5 in Papers on Methodology, Copenhagen, Ejlers, 1978.

33. Indeed, the harmony between all these actors, or limited, disciplined disharmony, is an essential precondition for all these organizations to function.

34. Yash Pal, in his contribution to the 25th Pugwash Conference, Madras, 13-19 January 1976, "Alternative Development Strategies for Developing Countries", makes a strong plea for scientists and technicians to work with the people in the villages, and also reminds us that "appropriate science and technology is not necessarily archaic science and technology".

35. I am indebted to Bernhard Glaeser for sensitizing me to this combination, particularly important in the field of locally self-reliant rural technologies with an initial high research input (such as new developments in the biomass field, in the coupling of algae dams to biomass converters, etc.).

36. Thus, much traditional technology, e.g. in the field of medicine, is so interwoven with religion (indeed, the effort to separate the two analytically is in itself very Western) that Westerners would probably feel rather alienated.

37. In sociological terms the Japanese structure combines the universalism of the Western approach (and not only Western) with the
Diffuseness of the traditional approaches – in patterns where workers and functionaries are treated very "objectively", but with a wide spectrum of their persons taken into account, not so narrow as in the West.

38. The closest project in the world today to this kind of idea, to our knowledge, is the UNDB project directed by Chandra Soysa from the Marga Institute in Colombo, Sri Lanka, "Sharing of Traditional Technology".

39. A personal experience: living in a high rise apartment house with absolutely no other heating possibilities than oil-fueled burners in the basement it stimulates thinking to read the janitor's note on the bulletin board to the effect that the temperature will be lowered by one degree per day (late fall 1973, Oslo – a very cold winter too).

40. See the papers referred to in footnotes 2 and 13 for more details about the crisis.