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SCIENTIFIC REVOLUTION AND INTER-PARADIGMATIC DIALOGUES

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CONTENTS

This paper is being circulated in a pre-publication form to elicit comments from readers and generate dialogue on the subject at this stage of the research. It was prepared for the Goals, Processes, and Indicators of Development Project meeting, Geneva, 2-8 October 1978, organized by the Human and Social Development Programme of the United Nations University. The views and opinions expressed herein are those of the author and do not necessarily reflect those of the University.

I INTRODUCTION

1. The purpose of this paper is to examine the role of inter-paradigmatic dialogues in the context of the contemporary scientific revolution.[1]

2. "Inter-paradigmatic dialogue" is defined here as an encounter between groups of researchers whose research is motivated by different values, and conducted with different goals, models, exemplars, and methods.[2] This encounter should aim at a mutual enrichment of the groups engaged in this process and the opening of new research frontiers; it should not become a confrontation about who is right and who is wrong.

3. It is clear that such inter-paradigmatic dialogues have not quite been fruitful in the past. Often encounters among different schools of thought have been a *dialogue de sourds;* and even when they have had a more positive appearance, the positivity has been due more to the participants' mutual praise of each other's oratorical skill than to a true effort for mutual enrichment.

4. Inter-paradigmatic dialogues such as the east/west peace research dialogue or the Christian/Marxist dialogue can be cited as examples of relatively fruitful dialogues, but even there it has been the extra-scientific circumstances that have led the opposing sides to listen to each other's claims rather than a real interest in promoting the progress of research.

5. My contention in this paper is that we are at a moment when a more fruitful inter-paradigmatic dialogue is indispensable if sciences – especially social sciences – have to meet the need of contemporary humankind. We will try here to determine the context within which such dialogues should take place and discuss the various conditions for their success.

II THE CONTEMPORARY SCIENTIFIC REVOLUTION

The Scientific Revolution in Social Sciences

6. It is probably superfluous to insist that the social sciences are entering a phase of scientific revolution in which a radical re-examination of various premises on which social theories are based is taking place. In certain countries one hears talk about post-behavioural revolution and radical economics; in others the effects of student uprisings have generated new value positions renovating the very basic assumptions of social sciences.[3] These trends are the more important in that they persist even after the social forces which have given birth to them have lost their initial impact.

7. All these developments deserve a more detailed analysis since they all disclose signs of transition and change departing from contemporary normal science. We will, however, avoid tracing a historical account of these trends, which are but a few forerunning signs of a much broader process of scientific revolution. We have reached a stage on the global level where the environmental circumstances directing the scientific activities of the researchers are revolutionary, and where the researchers themselves are producing new paradigms that are equally revolutionary.

8. The external conditions of scientific research have indeed changed during the past two decades, so radically that the researchers — especially in the social sciences — cannot stay within the boundaries of well-established normal science without failing to be relevant to the understanding of the contemporary world problématiques.

9. Among such new environmental conditions of modern sciences, the following trends are especially noteworthy.

10. Firstly, there is an increasing perception among academics as well as non-academics that the few paradigms which were associated with modern technocratic developments

are not answering the fundamental needs of human communities. The development of "big science," the invention of different forecast and planning methodologies, the progress of exact sciences, and the efforts to make "soft" sciences more rigorous, were certainly great achievements arrived at during the past two decades. Ironically enough, all these success stories have brought to the forefront of public attention the need to make science more relevant to the real needs of people, more responsive to their demands, and more socially responsible both on the national and on the international levels. Has not science been mostly developed in the service of war, in the service of corporate interests, in the service of the rich countries? Has not science failed to treat human beings as persons, turning them into mere numbers or, worse, using them as guinea-pigs? Many questions are raised now in different parts of the world about the basic values underlying scientific inquiry. More seriously, the great achievements of modern science are criticized for being based on mechanistic paradigms supporting and encouraging the abuse of power by technocracies. An excessive application of means-end rationality, when combined with the profit-maximization of capitalist societies or the production-maximization of centrally planned societies, necessarily leads to the pollution of the environment. Counter-scientific movements, even if they represent a small minority, ask embarrassing questions of the scientists who have so far been supported in all societies by the public and their governments. They themselves are more and more aware of the necessity of reconsidering their basic paradigms. Some anthropologists question the imperialistic nature of anthropology; some economists turn to the ecological paradigms; etc.[4]

11. A second noteworthy aspect of the global scientific scene is a growing awareness of the interdependence of humankind. This interdependence grows with the globalizing tendency of a modern economy. All kinds of phenomena which have appeared unrelated in the past tend to become interrelated and interlocked. This causes the emergence of a global problématique which forces scientists to study global phenomena, breaking the disciplinary – as well as the national – boundaries within which their research has been limited in the past. This globalization of science generally takes the form of a universal application of technocratic paradigms. However, combined with the anti-technocratic trends mentioned above, a new globally oriented trend in social science begins to emerge with a deeper concern for the factors forgotten by the technocrats. Human needs and values are found to be more complex and difficult to handle than the technocratic planners and the scientists at their service have tended to assume. Global planning is found to over-simplify a complex world where

regional, national, and local specificities have to be taken into account.[5]

12. A third increasingly important change in the global scientific scene is the fact that the basic assumption so far generally accepted – that modern science must be western science – becomes more and more questionable. It is true that modern science in its present form is based on paradigms generated in western societies, and its basic values, models, and exemplars are therefore naturally western. But this does not mean that there can be no alternative to the present version of modern science. That assumption contradicts the universality of science since its present version is insufficiently sensitive to the realities of non-western societies. Objectively, it fails to understand the social realities of the major part of the world, and as to the relevance of the research based on western paradigms, it is felt that it does not meet the fundamental needs of the non-western world. This dissatisfaction with western-centred paradigms encourages the creation of new scientific trends in the non-western countries. Scientists of different disciplines and cultures try to create paradigms more relevant to their socio-cultural realities. They try to rediscover the non-western endogenous scientific traditions to use them as a source of inspiration in paradigm-building.[6]

13. These three trends constitute the context within which the contemporary scientific revolution is taking place. This revolution is only at its first stage, and many researchers participating in it are unaware of the role they are playing because of the lack of co-ordination of their efforts. Most of them fight to open up new research frontiers in specific situations, and their paradigms necessarily differ from one situation to another.

14. At the present moment the scientific revolution is in its first phase, in which many well-established paradigms constituting the theoretical foundation of normal science are losing their legitimacy but no newly emerging paradigms have succeeded in acquiring a sufficiently wide support to replace them. Paradigms in decline and emerging ones are, so to speak, in a stalemate condition, and this situation may last unless the emerging paradigms can bring the scientific revolution to a new creative phase.

III SCIENTIFIC REVOLUTION AND DIALOGUE

15. The contemporary scientific revolution has so far been the result of a series of factors and no overall effort by any part of the scientific community has been made to orient it in a given direction. This lack of common purpose is an important cause of the difficulty for the various new paradigms scattered around the world in different disciplines and cannot combine forces to break the present stalemate between the existing normal science losing its ground and the new paradigms which are still too divided to replace it.

16. Under such circumstances, it is useful to try to define in "voluntaristic" terms the major objectives of this revolution as follows:

(a) to correct the biases of technocratic paradigms;

(b) to present the contemporary world problématique in its totality, taking into account all the interrelated and interlocked factors;

(c) to promote pluralistic science with a genuinely global coverage – i.e., including non-western paradigms.

17. These three points deserve some clarification. Firstly, technocratic paradigms emanate from the technocratic ideology, which makes technology a means to achieve power and use power to control the process of technological development. This ideology uses modern science primarily as a means to technological growth and turns it, to this end, into a body of knowledge which is pragmatic, mechanistic, rationalistic, uniformizing, and centralizing.[7]

18. The technocratic paradigms are unable to grasp the totality of the world problématique critically, since they limit their object of study to what can be profitably used to increase the power obtained through technological growth. This is why a holistic approach is indispensable to correct the biases of technocratic science. Since a holistic approach characterizes many non-western scientific traditions, a

pluralistic science including non-western paradigms must be built.[8]

19. Holism thus represents the approach guiding the contemporary scientific revolution. By taking a holistic approach, a researcher liberates himself from the mechanistic fiction which underlies contemporary normal science. According to this fiction, the researcher is expected to detach just a few factors or variables (from an immensely rich social reality) and should demonstrate that certain relations exist among them. The relationships among a few factors singled out by the researcher are grasped in such a way that "reality" becomes manipulable thanks to the enunciated statements relating independent variables to dependent variables. These relationships should be captured by a few universal statements which can be disproved. Sometimes, it is even claimed that what matters is statistical significance between independent and dependent variables.[9] In any case, a statement is valid only when everything else is held equal — i.e., an abstraction is made of all other aspects of reality.

20. This *ceteris paribus* approach is an important cause of the short-sightedness of many researchers. It limits their visual field to what can be manipulated usefully, leaving out important aspects of social and natural realities as "other things" to be held constant. The interest in determining the interaction between independent and dependent variables lead to an over-simplified view of natural and social realities.

21. The holistic approach requires a greater effort on the part of the researcher, who cannot rely on the *ceteris paribus* clause to ignore important aspects of the natural and social realities. A researcher believing in the value of statistical significance cannot just measure the variance of a dependent variable explained by a given independent variable. He must be able to identify all the dependent variables which are influenced by a given independent variable.[10]

22. The *ceteris paribus* principle provides a convenient alibi to the researchers who have no obligation to justify their choice as to the variables to study. In pure science it is generally admitted that any dependent variable can be investigated with equally good reason, provided that there is a reasonably high interconnection with the selected set of independent variables, a relationship which is often justified by the variance explained by a selected set of independent variables.

23. In scientific research linked to any kind of application, the choice of the

dependent variables to study will be determined by the interest in controlling a given factor. To manipulate a given dependent variable is the "end," and scientific inquiry defines the "means" by identifying the independent variables which will help this manipulation.

24. The question as to what are the different consequences of manipulating a given set of independent variables can be completely ignored thanks to the *ceteris paribus* argument. This is why, in designing a plant where the end is to produce a certain product economically (the dependent variable), the optimal combination of factors leading to such an end (the independent variables) are identified by leaving other things equal. The environmental pollution effects (another dependent variable) of the combination of factors are ignored in this equation.

25. It is only when one studies the complex ramifications among the many dependent variables influenced by a given factor – natural or social – and when they are grasped within the overall system of the natural and social realities, that science will be able to serve the multifarious interests of the different groups of humans and the various animal and vegetal species co-habitant in our eco-system.

26. Clearly, no researcher is capable of covering all aspects of the natural and social realities and identifing all dependent variables of any given independent factor. What can be done by a single individual is to define clearly the range of operation he chooses in view of his values and priorities. He must leave other researchers to conduct research in the fields not covered by him.

27. Clearly, too, the choice of dependent variables cannot be made on the basis of variance explained. It must be based on an extra-scientific choice made by the researcher. Therefore, holism implies that any researcher must accept a dialogue with his colleagues whose paradigms permit them to cover other aspects of the same "whole" his paradigm fails to capture. [11]

28. There is another point which deserves attention about the holistic approach. It is that it rejects the opposition between researcher and researched which is at the basis of technocratic paradigms.

29. If we agree to take a holistic approach, we must admit that the researcher and the

researched are both part of the same "whole" – i.e., we cannot assume that the researcher stays outside the researched reality. The researcher is indeed part of the universe he studies. The researcher is a member of a human group with a specific socio-cultural, politico-economic, historico-geographic, and organic-ecological background. The paradigmatic choice, as well as the research process of any natural or social inquiry, cannot be independent from this existential determinism (*Seinsverbundenheit*).[12]

30. As a result of this fact, it is wrong to believe in scientific objectivity – i.e., in an objectivity based on the opposition between an observed reality which is assumed to be objective to the extent that it is not "contaminated" by the observer, and an observing researcher who is "scientific" to the extent that he is a neutral bystander who avoids any involvement in the natural or social process he studies.

31. According to the theory of relativity, the mass of an object can be defined only relative to its space-time co-ordinates; and it is impossible, according to Heisenberg, to define the position of a particle and its velocity simultaneously. A basic transformation of perspectives is needed when one does not accept the existence of an objective reality and abolishes the subject-object dichotomy in both natural and social sciences.[13]

32. This consideration about the Heisenberg effect in science is also applicable to social science. This is an interesting theme which deserves special attention. But we must turn here to another important consequence of this shift of perspectives.

33. If researchers are part of the "whole" body of social realities, they must individually be various types of intellectuals with different socio-cultural, economic, and political backgrounds. If so, they cannot be considered to constitute a single monolithic "scientific community."

34. This leads us to take an entirely new approach to "research." Heretofore we were told that all researchers of a given discipline belonged to the same scientific community, sharing the paradigmatic base of normal science, and that they conducted research on this common ground of inter-subjective communication and understanding. This monolithic community was assumed to conduct research on a "reality" which could be cut into pieces to be analyzed independently from the whole reality. In brief, any research process was a one-to-many interaction between a single bloc of researchers

and manifold aspects of reality researched separately.

35. Now, we find that researchers have to be considered as a pluralistic community in which different paradigmatic groups interact among themselves. They are engaged in research which focuses on some aspects of natural and social reality, and it is only by interacting among themselves that they can grapple with the totality of this reality. In other words, the research process involves many paradigmatic schools of researchers conducting research on reality, which constitutes a single body of interrelated factors which cannot be simply dissected into discrete parts. Thus, the research process must be seen as a many-to-one interaction between a plurality of paradigmatic groups and a single object of research, "reality."

IV LISTEN TO THE VOICE OF THE VOICELESS

36. The holistic approach implies a fundamental transformation, a "metanoia" of social inquiry. The boundary between the group of researchers and the group of researched should be broken.

37. Therefore, inter-paradigmatic dialogues cannot be undertaken among researchers only; and inter-paradigmatic encounters cannot ignore those whose interests are at stake – the people about whom and in whose name the parties engaged in the discussion often talk without credentials.[14]

38. There is an academic tradition, enhanced by the emergence of technocracy, according to which specialists have to talk in the name of the "common man," whose interests are supposed to be best guaranteed by this delegation of power.

39. This specialist/common man dichotomy is not only morally untenable; it is often also a major cause of the lack of scientific creativity on the part of social scientists who develop a closed academic community where old theories and models prevail.

40. Even more importantly, the scientific technocratic language with its analytical syntax and its means-end rational vocabulary is deprived of the synthetic wisdom contained in the common sense of the "common man."

41. It is deprived of the rich diversity of the various cultural traditions expressed in different national vocabularies. According to Jean Duvignaud, there is a lost language – that of those alienated culturally or economically from the modern industrial centres of intellectual power, the "savages" and the proletariat – which should be re-learned by scientists, especially social scientists. Otherwise, inter-paradigmatic dialogues will lack an enriching factor upon which the very success of the scientific revolution may depend.[15]

42. The problem of language and vocabulary in inter-paradigmatic dialogues is indeed crucial, as we will see later. Two contradictory requirements have to be met simultaneously. On the one hand, a commonly understood lingua franca is indispensable. On the other hand, the parties engaged in a dialogue should not dilute their specific syntactic styles and vocabularies in this common language and thereby lose the sharpness of their paradigms and their analytic power. This general dilemma is most strongly felt when the dialogue involves scientists and non-scientists.

43. It is often said that scientists should forget their jargon and speak the common language of the people with whom they must interact. However, the relationship of scientists and lay people in the inter-paradigmatic dialectical process is not that simple. Although it is true that an overly sophisticated scientific vocabulary is often simply a means to conceal one's lack of creativity behind a verbal smoke-screen, it is impossible to deny that the specific contributions of any paradigm are based on the effective use of special key concepts that are not to be found in common language. To force the researchers to "translate" those key terms into everyday language may be lethal to the paradigm if the translation does not convey faithfully all the denotative and connotative richness of the original scientific terms.

44. What is more meaningful than a literal translation of scientific terms into common language is the establishment of a genuine dialogue between the researchers and the people in which the researchers make all necessary efforts to listen to and understand the people's way of thinking, theories, and models deeply embedded in their everyday vocabularies.

45. Once such a listening process exists, it becomes easier for the researchers to relate their own concepts to the relevant counterpart in the popular tradition of the interlocutors. It is by an effort to explain scientific concepts and logic in such a way that it can be relevant to the everyday life concerns of a human community, rather than by finding a literal translation of each word, that communication between the often too vocal researchers and the "voiceless" alienated peoples can become fruitful.

46. In concrete terms, this implies, on the part of the former and of the latter, a mutual learning effort to share experience, to invent together a common language, and to improve it through intensive debate and discussion. The vocabulary and literary style of Mao Tse-tung, combining scientific terms of the Marxist paradigm with concepts and

exemplars of the Chinese popular tradition, is a good example of a style of expression formed through a long mutual learning process of researcher/activists and the people.

47. Needless to say, such a mutual learning process requires a high degree of motivation on the part of both parties. What is important is not an easy-to-understand language but a common "sense of purpose." The researchers should be genuinely determined to be with the voiceless people; they should have a political will to side with them. Otherwise, the use of common language becomes a means to sell the ideas of the researchers to the people.

V THE POLITICAL DIMENSION

48. Not only dialogues involving non-researchers but also any inter-paradigmatic dialogues always take place in specific political contexts. Even when the content of the discussion is purely scientific, the researchers cannot be considered purely intellectual creatures like angels. Any researcher is an intellectual with a given socio-cultural, economic, and political background, and his thinking reflects this fact. [16]

49. It is in this connection that the inter-paradigmatic dialogical process needs to be organized with the greatest care. This process should not be blind to political realities and just aim at a mutual understanding and a mutual accommodation among all possible paradigms, but rather should encourage each paradigmatic group to define its own political position unambiguously and engage in dialogue with other groups with full awareness of the political implications of such a dialogue. Do the parties engaged in the dialogue represent antagonistic political positions or not? Do they share a common political aim? These are extremely crucial points to determine.

50. To be sensitive to political realities does not mean to turn inter-paradigmatic dialogue into a political debate. A clear distinction exists between the "political arena," where the clashes and competitions of interests and of ideological positions prevail over scientific reasoning, and the "scientific forum," where a commonly agreed upon acceptance of the rules of the game of scientific inquiry prevails over such clashes and competitions.

51. In concrete terms, the major contradiction in the contemporary scientific forum exists between the groups of researchers holding technocratic paradigms and choosing to maintain the established normal science and those adopting non-technocratic paradigms and supporting the present scientific revolution. In this context the success of the revolution depends first on an inter-paradigmatic dialogue among those holding the innovative paradigms, leading to a more coherent common position, a common

front, in the great dialogue with the supporters of normal science. Indeed, a dialogue among groups holding any paradigms, as long as it is aimed at bringing about socially, and hence politically, relevant results, should take into account the various "contradictions" which oppose the concerned paradigms or make them natural allies of each other.[17]

52. The contradictions opposing paradigms may be methodological, theoretical, or more deeply rooted in their basic value assumptions. The generally accepted rule of the game in scientific dialogue is to limit mutual criticism to the methodological and theoretical aspects of research, leaving out the value aspect, which is considered subjective and therefore ascientific.

53. My contention is that the value positions compatible with a given paradigm are a more fundamental subject for dialogue than methodology and theory, since the inter-paradigmatic dialogical process is an integral part of the social and political dialectical process of history and the values underlying paradigms determine their contribution to the overall historical process.

54. In other words, even if the arena and the forum are two separate settings, we must consider inter-paradigmatic dialogues not only as a "scientific" exercise but also as a "praxis" of the various types of intellectuals contributing to the historical process.[18]

55. Intellectuals can be organic or disorganic; they can work to strengthen either the hierarchic and bureaucratic alpha or the communal and egalitarian beta structures; they can serve the interest of various social classes and justify different ideological projects. Paradigms can be viewed as intellectual tools in the hands of different groups of intellectuals who seek to control the intellectual scene – nationally or internationally – by forming inter-paradigmatic alliances directed toward the materialization of common projects. This is where major and minor value contradictions among different paradigms have to be distinguished. If inter-paradigmatic dialogue does not mean simply a polite and superficial mutual understanding among intellectual opponents, it should be based on a realistic recognition of the fact that in this changing world there is an important intellectual competition taking place among different paradigms aiming at building the world of tomorrow according to each one's values.[19]

56. The contemporary scientific revolution corresponds to a broader political change,

in which the global trend is to turn away from the abuse of over-technocratization. This new trend, fighting against strong counter-currents, appears in societies with different social systems and political regimes. It appears also on the international level, where it takes the form of a contestation against the technocratic hegemony by the centre over the periphery. In this global historical process, forces opposed from without the techno-structures, i.e., all the anti-technocratic movements fighting for such diverging causes as democratization and environment conservation, and forces from within trying to make technocratic rule more responsive and flexible, i.e., the supporters of socio-technocracy or of techno-democracy, fight against the centralizing power of national and multi-national technocracies.[20]

57. In this historical context, the supporters of the scientific revolution must form a large front in which the paradigms developed by all the intellectual groups fighting against the abuse of technocratic rule, from without as well as from within, combine forces in their critique of the technocratic paradigms prevailing in the present normal science. A global collaboration of all concerned parties is necessary in order to build non-technocratic science and technology.

58. The formation of a front composed of the anti-technocratic paradigms in the scientific forum poses serious organizational problems because of the structural characteristics of the scientific community in the world today. Normal science supported by technocratic paradigms is developed by the great academic institutions in the centre of the international community of science and transferred to the periphery through a trickle-down process. The counter-technocratic paradigms generated by an active minority in the "centre" can also benefit from the "centre-periphery" structure and gradually infiltrate the various sectors of the "periphery." In a sense, the myth of economic development has been propagated by the technocratic science transferred from technocrats of the centre to those in the periphery. The cultural mimetism of peripheric capitalism perpetuates the dependence of the Third World. This is why a decolonization strategy implies the de-technocratization of science and technology.[21] Now, due to the very nature of a centre-periphery structure, it is extremely difficult for the counter-technocratic paradigms in the periphery to become known and accepted by the scientists in the centre or in the other parts of the periphery. This is why it is crucial for the success of the scientific revolution to mobilize all counter-technocratic paradigms by organizing a network of communication and dialogue, laying a strong emphasis on the periphery in order to counteract the centre-to-periphery control of today's technocratic normal science.[22]

VI A TRI-POLAR STRUCTURE

59. By the very nature of scientific logic, which is binary, intellectuals tend to form bi-polar structures with two opposed camps rallied under two paradigmatic banners. The polarization often takes place even within each of the two poles, which then divide themselves into two sub-poles, and so on and so forth.[23]

60. An inter-paradigmatic process should be able to break the bi-polarity of the intellectual community by introducing a third pole in the dialogical process.

61. The introduction of a third pole in a dialogical process is meant to destabilize the intellectual equilibrium which exists between two paradigms, dividing a given intellectual community into two opposing poles. The third pole is therefore not a pole of conciliation; rather it is a pole of novelty, a pole of creative chaos, which asks the two poles new questions, forcing both of them to reconsider their basic assumptions.

62. The role of a third, "chaotic" pole in an inter-paradigmatic dialogical process may be difficult to conceive when one takes an "A versus non-A" approach to dialogue. Let us use an allegorical representation of the relationship between a bi-polar cosmos and a chaotic third factor to liberate our minds from the dualism of formal logic: According to the tale of the three kings in Chuang-tzu, the King of the Southern Seas and the King of the Northern Seas met at the central kingdom of King Chaos. To express their gratitude to King Chaos for his hospitality, the kings of the two seas decided to give Chaos – who had no sensory organs – two eyes, two ears, two nostrils, and a mouth. They carved one organ each day, and after a week, when King Chaos had received all the seven organs, he died. This myth symbolizes the opposition between the cosmos based on reasoning and chaos, which is insensitive to sensory perception and free from binary logical constraints. Chaos dies when he has to fall under the domination of sensory data and formal logic.[24]

63. Through this mythological expression, the function of the third pole in the inter-paradigmatic dialogue becomes clearer: It is a pole which is not bound by the rigid paradigmatic constraints of the two others. The role of such a pole is to introduce extra-paradigmatic considerations and to break the dichotomic argumentation by bringing innovative ideas into the discussion.[25]

64. The third pole's role can be played by any of several types of intellectual groups. The most likely group is an innovative splinter group of one of the two poles. A group of researchers dissatisfied by the stalemate situation which exists between their paradigm and a counter-paradigm decide to propose an innovation of their own paradigm and thus set a process in motion which destabilizes the existing order. An example of such a group is the radical economists who come to break the bi-polar opposition between "modern" and Marxist economics.

65. A second type of the third pole is formed by extra-paradigmatic groups who call the attention of the academic communities to the existence of new problems which have not been researched by the two opposed paradigms. The term "extra-paradigmatic" is used here to cover a large variety of groups, some belonging to other scientific disciplines, others being semi-academic or non-academic. An example where both groups are involved is the ecology movement composed of citizens' groups and natural scientists, which is forcing modern and Marxist economists to open up a new field of research, thus destabilizing the existing equilibrium.

66. A third kind of chaotic pole is sometimes formed around national or international institutions or organizations which help physically to break the existing bi-polar order. We use the term "physical" here because such institutions and organizations do contribute to the physical contacts of researchers belonging to the two opposed communities. The physical compartmentalization which allowed the two poles to develop their theories as in-groups without any exchange of information with each other is broken by new contacts which bring chaotic bits of thought and information into the two schools of thought. The existing order is thus replaced by a fluid situation in which new ideas can grow more easily.

67. A fourth possibility which exists for a chaotic pole to emerge exists wherever researchers engage in dialogue with the people. The rich reservoir of popular wisdom is the best antidote against the bi-polar fixation of scientific paradigms. The encounter

between the analytical logic of science and the holistic, synthetic logic of popular wisdom – especially in the non-western world – is bound to break the cosmos of contemporary normal science and bring an element of creative chaos into the inter-paradigmatic dialogue.

68. We have seen that the third pole plays a destabilizing function by revising existing paradigms, by taking up new questions, by breaking the community base of paradigms, and by bringing in a creative chaos. In the real world, all these functions are mixed in a process in which the various types of groups mentioned above interact, often unconscious of their function, and bring different kinds of destabilizing factors into the existing bi-polar order.

69. The activation of a third chaotic pole in inter-paradigmatic dialogues is a basic condition of a successful scientific revolution. Otherwise, the dialogues would merely take the form of open debates to which the opposed schools of thought send their best champions for a scholastic exercise with *concedo*'s, *nego*'s, and *distinguo*'s, leading to nothing else but a reaffirmation of one's paradigmatic superiority over the other without any contribution to the innovative thinking indispensable for the success of the scientific revolution.

70. The importance of a third pole is especially great at the present stage of the scientific revolution because of the previously mentioned centre-periphery structure of the "scientific forum." As long as the dialogue takes place within the centre-periphery structures, it is extremely difficult for a free exchange of thought to take place unimpaired by the inequality and assymmetry of the basic conditions within which researchers in the centre and in the periphery operate. A third pole should be formed as a forum where the centre-periphery opposition does not predetermine the conditions of joint research and dialogue. Such a "liberated zone" could become the intellectual base from which new paradigms may emerge out of a creative chaos generated by the north/south dialogues. In concrete terms, this means that a new academic setting, outside the international academic structures based on universities, academics, and foundations, should provide a place free from the centre-periphery division which prevails among those universities, academic institutions, and foundations.[26]

71. How can a chaotic "liberated zone" avoid the technocratic temptation of centralized planning in research project management? The concept of multi-disciplinary

networks developing research strategies progressively through a horizontal self-steering mechanism is at least one way to minimize the danger of technocratization and maximize the creativity of the third pole.

VII BEYOND FORMAL LOGIC

72. The inter-paradigmatic dialogues are, by their very nature, dialogues between researchers whose researches are based on different assumptions and use different concepts, models, and theories. The ways they cut (*découpage*) social realities into identifiable pieces are often quite different. A dialogue is, therefore, successful only if the parties can compare each other's paradigm with the best understanding of each one's own concepts, models, and theories.

73. In a dialogue among researchers holding the same paradigm, it is possible to concentrate on the question of validity and accuracy. A rigorous comparison of both sides' arguments based on the laws of identity, contradition, and excluded middle is most useful because the shared paradigm provides a clear logical ground for an exercise testing validity and accuracy using formal logic as a common language.

74. When it comes to comparing research generated by different paradigms, the interest of the dialogue lies in an entirely different field, that of the relevance of each paradigm. In natural sciences it is futile to discuss whether light is a wave or a particle (and indeed modern scientific theory rejects the law of contradiction by admitting that it is both a *wave = non-particle*, and a *particle = non-wave*) and the only question that makes sense is what aspects of the phenomena related to light can be best studied by assuming one or the other of the two definitions. Inter-paradigmatic dialogues — not only in natural sciences but also in social sciences — should not be concerned with the determination of who is right or wrong in defining a concept one way or the other. They should rather concern themselves with the question of what part of the natural or social realities is best approached by one or the other position.

75. Two formally contradictory definitions of the same social reality may be both relevant and complementary in shedding light on different aspects of it. This is why the logic of inter-paradigmatic dialogue cannot be bound by the laws of Aristotelian formal

logic: identity, contradiction, and excluded middle. There may not be any common language accepted by both parties. There is only a reality accepted by both but formulated by means of a vocabulary which often does not permit clear comparison between statements made by the parties holding diverse paradigms.

76. Combinatorial structuralism may, of course, claim that is is possible to find the group structure underlying different paradigms, as in the analysis of myths. Unexpected structural similarities can be found among myths which appear on first sight completely unrelated. A similar treatment may show unexpected similarities among different paradigms.[27]

77. Although this approach may be appealing by its elegance, we must not forget that paradigms are not only logical but "logico-real" structures in that they cut natural or social realities into disjoint entities. A group theoretical treatment of concepts used by a given paradigm is insufficient because it deals only with the structure of the *signifiant* system (the logical level) without touching on how the *signifié* realities (the reality level) are decomposed when one relies on a given paradigm.[28]

78. This "logico-real" aspect of the relationships between the logical and the reality levels call for a study of the morphogenesis of the paradigms. Catastrophe theory helps us here since it sheds light on the different logical positions in the morphogenetical space. To take an imaginary example which does not concern contemporary inter-paradigmatic disputes, the *signifié* in a mythological field could vary from gods to humans with a grey zone of god-heroes or god-human-animal figures. Beside the logic of transformation among the *signifiant* group of gods, humans, and other figures, there is the logico-real problem of determining the cutting point, or catastrophe, which distinguishes gods from humans and from mythical animals.

79. A major difference between the two levels of *signifiant* and *signifié* lies in the fact that the former is composed by discrete concepts while the latter is a continuous space. Therefore, it becomes necessary to apply a catastrophe theoretical model relating the continuous reality (i.e., the *signifié*) with the discrete set of concepts (i.e., *signifiant*).

80. The simplest case is that of a cusp where a pair of conflicting concepts X and Y are assigned different values (see Figure 1). Depending on the control, i.e., the paradigm adopted by a researcher, the definition of an aspect of the reality (the *signifié*) is

represented by a point on the phase space which determines the concept (the *signifiant*) applied to reality. At some points in the upper side of the space the reality is defined to be Y and not X. At some points in the lower side of the same space it is defined as X and not Y. At the point in the centre, reality is defined as X and Y. There is a point where the laws of identity and contradiction X = X, X ≠ Y do not hold.[29]

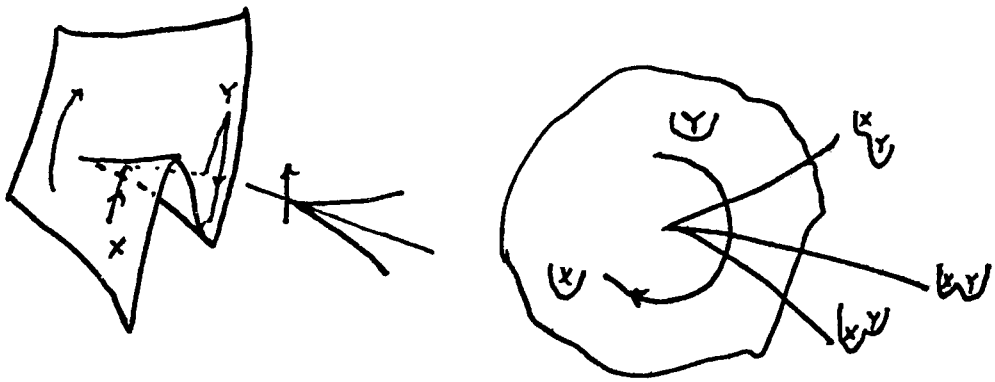

Figure 1

81. In other words, one should not exclude the possibility that two contradictory statements based on different paradigms have to be considered both true (or also both false).

82. This leads us to refer to the following non-formal-logic model to find the logical base of inter-paradigmatic dialogues. The tetralemmic model which has been developed in oriental logic stipulates the existence of four lemmas:[30]

(a) affirmation,

(b) negation,

(c) non-affirmation and non-negation,

(d) affirmation and negation.

Both (a) and (b) belong to formal logic, but (c) and (d) are unacceptable to it. As we saw before, modern science accepts (c) and (d) when it says that light is both wave and non-wave, particle and non-particle. The interest in stressing the two non-formal-logic lemmas lies in the fact that it allows a dialogue to go beyond a mere debate on the pros and cons of opposite paradigms.[31]

83. Such a claim may seem unacceptable to anybody whose mind is predetermined by formal logic. In the Mahayana tradition, however, (c) and (d) are distinguished as lemmas of excellence (*paramārtha*) in comparison to (a) and (b) which are the mundane

(*saṁvriti*) lemmas. In a dialogue, (c) represents a moment of truth where both parties transcend the limited space provided by their respective paradigms and realize that to affirm or to negate are both meaningless. The lemma (d) is reached by reverting (c). Affirmation and negation being both negated, the very fact that reality is embedded in contradictions is accepted by the parties engaged in dialogue. They come to accept both *affirmation* and *negation* as part of the reality of which their paradigms grasp only a few aspects.

84. Let us propose here an example of a dialogue, non-scientific but still relevant in providing a clearer insight on the tetralemmic approach. A dialogue about social praxis between those who believe in God and those who do not can be fruitful only when both parties reach a point where the question of theism or atheism becomes not merely a logical question about the affirmation or negation of the concept of God but rather an existential problem of the motivation both parties have in their social praxis. Both parties can reach a point where they see the futility of quarrelling on a formal logical level and see that any social praxis must recognize the historical role of both those who believe in God and those who do not. This realization is not an eclecticism nor a syncretism; it is the affirmation of two contradictory positions not on the level of formal logic but on the existential level of social praxis.

85. The adoption of a tetralemmic approach will correct the biases of technocratic paradigms by pointing out the limitations of means-end rationality. Only an acceptance of the third and fourth lemmas can allow a full representation of the contemporary world problématique in its totality, since contemporary world reality is full of cases where a mere affirmation or negation does not make sense. Tetralemma is a non-western paradigm which *complements* the Aristotelian logic of western science and which will permit the scientific revolution to go beyond its present stalemate into its constructive phase. It is an approach which helps to relate in a holistic context various paradigms. It fulfills, furthermore, the three objectives of the contemporary scientific revolution mentioned in paragraph 16.

VIII CONCLUSION

86. The contemporary scientific revolution can be successful only if an effective inter-paradigmatic dialogue can be organized. An inter-paradigmatic dialogue can be successful only if a scientific revolution gives the researchers new insights indispensable for such dialogues.

87. This circularity of the arguments presented in this paper calls for a spiral strategy. All the researchers participating in the contemporary scientific revolution must aim at building a spiral process in which an inter-paradigmatic dialogue generates new approaches and new approaches encourage further dialogue.[32]

88. The formation of a critical forum for such dialogues is urgently needed.[33] And the intellectuals of the world who are bearers of different cultural traditions should co-operate with the people of the world in order to open new research frontiers where the many pressing global problems can be studied for the benefit of all.[34]

NOTES

1. A scientific revolution is defined by Thomas S. Kuhn as "those non-cumulative development episodes in which an older paradigm is replaced in whole or in part by an incompatible new one" (Thomas S. Kuhn, *The Structure of Scientific Revolutions* [Chicago, 1962], p. 92). Kuhn sees such revolutions as radical changes of world views, "as if the professional community had been suddenly transported to another planet where familiar objects are seen in different light and are joined by unfamiliar ones as well" (ibid., p. 111). On inter-paradigmatic dialogues, cf. Kinhide Mushakoji, "Peace Research as an International Learning Process – A New Meta-Paradigm," *International Studies Quarterly*, Vol. 22, No. 2 (June 1978).

2. We define "paradigm" in a formal way as a combination of (a) values adopted as goals aimed at by researchers, (b) a problématique or set of problems grasped as part of an interrelated whole represented by a number of models, (c) a theoretical construct built on a selection of exemplars, and (d) rules of the game called "scientific research," determining the legitimacy of certain scientific methods as opposed to other unscientific procedures. Each of these four components of a paradigm can be more or less strictly defined, so that certain paradigms emphasize the right choice of certain value positions or the utilization of certain methods, leaving the researchers a more or less broad choice of methods in the former case and of values in the latter.

3. On the post-behavioural revolution in the United States, cf. T.J. Lowi, "The Politics of Higher Education: Political Science as a Case Study," in G.J. Graham, Jr., and G.W. Garey, eds., *The Post-Behavioral Era: Perspectives on Political Science* (New York, 1972), pp. 11-36. In connection with the impact of the May 1968 movement in France, cf. Jean Ziegler, *Sociologie et Contestation* (Paris, 1969), pp. 247-249.

4. As to the analysis of technocratic science in general, cf. Jurgen Habermas, *Toward a Rational Sociology* (Boston, 1970); Alvin W. Gouldner, *The Dialectic of Ideology and Technology* (New York, 1976); Hans-Georg Gadamer, "Theory, Technology, Practice: The Task of the Science of Man," in *Social Research*, Vol. 44, No. 3, pp. 529-561. As to the problems of technocratic science in the Third World, cf. Ignacy Sachs, *The Discovery of the Third World* (Cambridge, Mass., and London, 1976), pp. 82-99.

5. The sequence of reports to the Club of Rome starts with Dennis Meadows' *The Limits to Growth*, based on global aggregate statistics extrapolation. The following report by Mihajlo Mesarovic and Eduard Pestel, *Mankind at the Turning Point*, attempts to disaggregate the global figures into regional ones; so does the Latin American model of Amilcar Herrera, catastrophe or New Society. The latter does, however, base its assessment on basic needs satisfaction, thus putting the human individual at the centre of the model. Ervin Laszlo's *Goals for Mankind* stresses then the importance of value pluralism.

6. As to the need to develop an endogenous social science tradition in Asia, cf. Syed Hussein Alatas, "The Captive Mind in Development Studies: Some Neglected Problems and the Need for an Autonomous Social Science Tradition in Asia," *International Social Science Journal*, Vol. 24,

No. 1 (1972). See also a discussion on dependency in social science: Chadwick F. Alger and Gene M. Lyons, "Social Science as a Transnational System," *International Social Science Journal*, Vol. 26, No. 1 (1974). The need to develop indigenous social science to remove dependency is stressed in: Canadian Commission for Unesco, *Model Elements for the Social Science Programme of Unesco*, International Workshop, Stanley House, New Richmond, Canada, August 15-19, 1977 (Ottawa, 1977).

7. Thus the technocratic paradigms develop approaches which stress the following basic assumptions:
   (a) the manipulability of nature and society (pragmatic),
   (b) the possibility of partitioning the world and defining the interactions among a few parts of it, leaving other things equal (mechanistic),
   (c) the primacy of means-end rationality as a basic value (rationalistic),
   (d) the constant need to standardize scientific methodology (uniformizing),
   (e) the perpetual growth of science through centralized research and development investment made by scientific policy-makers (centralized).

8. One may claim that technocratic paradigms can also be holistic — i.e., aim at grasping the totality of the state of the world. It is true that there are a few technocratic paradigms stressing interdisciplinary or multi-disciplinary approaches. However, to be interdisciplinary or multi-disciplinary means only that a larger part of the world is covered, not its totality. As Adorno rightly points out, "totality" is "not an affirmative but rather a critical category." To grasp the world in its "totality" implies taking into consideration contradictions among factors which are often not yet part of the world technocrats can grasp by means of their positivistic methods. These factors can only be studied through critical and dialectic methods, quite different from the interdisciplinary or multi-disciplinary approaches. See Theodor W. Adorno et al., *The Positivist Dispute in German Sociology* (New York, 1969), p. 12. As to the holistic wisdom of non-western scientific traditions, Keiji Yamada writes that Chinese science tried to grasp the network of meaning of the totality of the objective world not through a theoretical system but through a classification of the types of transformation of a few basic patterns into their variants. This characteristic of Chinese science is presented in the chapter "Patterns, Recognition, and Creation: The Intellectual Climate of Chinese Science," in Keiji Yamada, *Konton no Umi e: Chugoku-teki Shiko no Kozo* [In a Sea of Chaos: The Structure of Chinese Thinking] (Tokyo, 1975), pp. 115-176.

9. This tendency to believe in the significance of "statistical significance" often leads to failure to observe the theoretical foundation of the concept, and many researchers apply the significance test without providing sufficient evidence that (a) there is an appropriate sampling from a universe, and (b) the sampling distribution model is known.

10. Let the variance of a given variable y^* be $V(y^*)$. In a conventional analysis the problem consists of determining a set of variables, $x_1, x_2, \ldots, x_n$, considered as independent variables where the covariances $V(x_1, y^*), V(x_2, y^*), \ldots, V(x_n, y^*)$ add up to $V(y^*)$.

$$V(y^*) = \sum^{n} V(x_i, y^*)$$

or

$$\sum_{i=1}^{n} P(x_i | y^*) = 1$$

where

$$\sum_{i=1}^{n} P(x_i | y^*) = \sum_{i=1}^{n} (V(x_i, y^*) \; V(y^*))$$

or

$$P(x_i | y^*) = V(x_i, y^*)/V(y^*)$$

Now if we want to ascertain all the major consequences of y^* over a set of dependent variables $z_1, z_2, \ldots, z_m$, we must $P(y^* z_1) \ldots P(y^* z_m)$. The total variance of z_j, $V(z_j)$ is the sum of the covariance with all the independent variables, say y^* and $y_{j1}, y_{j2}, \ldots, y_{jk}$. Therefore, we have

$$\sum_{h=1}^{k} P(y_{jh} \mid z_j) + P(y^* \mid z_j) = 1$$

but such relationships tell us nothing concerning other Z's: for any Z_j, $j' \neq j$

$$\sum_{j=1}^{m} P(y^* \mid z_j) \neq 1$$

more precisely

$$P(y^* \mid Z_j) + \sum_{h=1}^{k} P(y_{jh} \mid Z'_j) \text{ may be } > 1 \text{ or } \leqq 1$$

That is to say, y^* can account for a large percentage of the variance of any number of variables z_j dependent on it, but it may not do so, even with the help of previously chosen $y_{ji} \cdot y_{ji}$ s which were useful in accounting for Z_j.

Consequently, whereas it is possible to determine a group of independent variables and say that they account together for a high percentage of the total variance of y^*, it is impossible to identify all the dependent variables of y for which y^* accounts for a high percentage of their variance, and it is always possible that a variable unnoticed by the researchers is strongly dependent on y^*. This leads to a model reversing the Bayesian statistical approach, but this point is beyond the scope of this paper.

11. In other words, we consider *holism* on two levels. On the first, we distinguish holistic paradigms from mechanistic-analytical paradigms. On the second, we define holism as a meta-paradigm which insists on the pluralistic application of analytical and holistic paradigms so as to grasp the whole of the natural and social realities. The holistic paradigms on the first level can be subdivided into organic and hermetic paradigms (cf. Kenzo Sakamoto, "Mittsu no kagaku to sono gensen" [Three sciences and their sources], *Tembō*, No. 231 [March 1978], pp. 61-79). Our criticism of technocratic science is based on the fact that it does not accept the coexistence of mechanistic and holistic paradigms. We do not reject mechanistic-analytical paradigms provided they are put in the larger context of the holistic meta-paradigm so that means-end rationality does not become an end in itself.

12. As is pointed out by Karl Marx, it is the social existence of human beings which determines their consciousness. Many interesting analyses have been developed by researchers belonging to different schools of thought, such as Marxism, existentialism, and the sociology of knowledge. Cf. Georg Lukacs, *Geschichte und Klassenbewusstsein* (Berlin, 1923); Jean-Paul Sartre, *Critique de la Raison Dialectique* (Paris, 1960); Karl Mannheim, *Ideology and Utopia* (London and New York, 1952).

13. This leads to the concept of incommensurability of scientific theories. Cf. P.K. Feyerabend, "Explanation, Reduction and Empiricism," in H. Feigl and G. Maxwell, eds., *Minnesota Studies in Philosophy of Science*, Vol. 3 (Minneapolis, 1962).

14. Proudhon's "collective reason" (*raison collective*) emerges out of confrontation among people with diverging interests and ideologies — i.e., out of inter-paradigmatic dialogues. Although this reason is alienated and dominated by capital, state, and church, it can liberate itself through the combined efforts of the people and the intellectuals undominated by "transcendental" or "private reason." Pierre-Joseph Proudhon, *De la Justice dans la Révolution et dans l'Eglise: nouveaux Principes de Philosophie pratique* (1858).

15. Jean Duvignaud proposes the rediscovery of the "lost language" (*le langage perdu*) of the workers and of the "savages" (*sauvages*) who seek a life-style different from that imposed on them by an imperialistic and ravaging industrial society. Anthropology's true vocation, for him, is to discover foci of creativity hidden in the human communities not dominated by economic growth. In other words, anthropology must rediscover the "lost languages" of these groups forced to be silent. See Jean Duvignaud, *Le Langage Perdu: Essai sur la Différence Anthropologique* (Paris, 1973). In a more praxis-oriented context, cf. Paulo Freire, *Pedagogy of the Oppressed* (New York, 1970).

16. As to the double dialectics of social classes, making intellectuals both free and creative and at the same time representative of the interests of the ruling class, and as to the need of historical research on intellectuals, see Alain Touraine, *Sociologie de l'Action* (Paris, 1965), pp. 140-141. For an interesting attempt at self-analysis on the role of the intelligentsia in the struggle between the forces of popularism and of the military technocrats in Latin America, see Candido Mendes, *Después del Populismo* (Buenos Aires, 1974).

17. In formal logic contradictions have to be eliminated by determining what is true and what is false. In praxis, minor contradictions are set aside temporarily in face of major contradictions. On this point, cf. Yamada, op. cit., pp. 109-114.

18. Inter-paradigmatic dialogues can be seen as a praxis of crucial importance for the intellectuals as cultural activists (*militants culturels*). Cf. Touraine, op. cit., p. 450.

19. Power politics is accompanied by a competition among different *civilizational projects*. Thus it is essential for the emerging countries to be *self-reliant* to increase their potential of *endogenous intellectual creativity* while forming links of *non-antagonistic* relationships enhancing "independence through interdependence." On this international political dimension of inter-paradigmatic dialogue, cf. Anouar Abdel-Malek, "Historical Surplus Value Positions" (paper presented at the Ninth World Congress of Sociology, Paris, 1978, mimeographed).

20. We must take note of all the important attempts to make technocratic rule more responsible and responsive to popular demands. As long as bureaucracy and technology exist, bureaucrats specializing in technological planning will not disappear. What can be and should be done is to transform techno-structures and change the mode of operation of those bureaucrats who serve them. Cf. John Kenneth Galbraith, *The New Industrial State*, 2nd ed., rev. (Boston, 1971); idem, *Economics and the Public Purpose* (Boston, 1973).

21. Cf. Celso Furtado, *Le Mythe du développement économique* (Paris, 1976); Ali A. Mazrui, *The Computer Culture and the New Technocracy: Towards Redefining Development in Africa* (IPSA/CUDM Round Table paper; Ann Arbor, Michigan, USA, 1978).

22. The present scientific revolution has to be backed up by an activating process of the world academic community. This process "should aim at redressing the centre-periphery structure of the academic world where the centre transfers to the periphery conventional approaches to development research" (United Nations University, "Report of the Planning Meeting of the Human and Social Development Programme Advisory Committee Held at University Headquarters, 17-21 January 1977" [Tokyo, 1977], Annex II, p. 3).

23. Keiji Yamada has built a theory of polar structures which he has used to study the industrialization process of modern China. He distinguishes uni-polar, bi-polar, and tri-polar structures on two levels, superficial and fundamental. For example, the traditional bi-polar structure opposing landlords to peasants was transformed through the creation of a third pole, the rural liberated zones, which played a fundamental role in breaking the stagnation of the bi-polar structure. See Yamada, op. cit., pp. 241-264.

24. Cf. Mikisaburo Mori, trans., *Sōji* [Chuang-tsu], *Nai-hen* (Tokyo, 1974), p. 203.

25. Beside the idea of a third pole, it is possible to search for an overarching paradigm which includes two opposite paradigms as special cases. Such a paradigm can be acceptable only when the two opposite schools of thought come to accept their paradigms as partial, an attitude which can rarely grow out of a polarized situation in which each of the parties seeks to "prove" its approach to be better than the other. This is where a third pole which destabilizes this belief in their own "righteousness" held by both poles becomes an indispensable catalyst in bringing about the acceptance of such an overarching paradigm.

26. According to the Expert Group on Human and Social Development convoked by the United Nations University, the role of a third chaotic pole in inter-paradigmatic dialogues in promoting the contemporary scientific revolution can and should be played by the United Nations University. They stress, "The University should not be afraid of controversy: on the contrary, it should encourage it. It should serve as a meeting ground for the articulation, comparison and confrontation of different approaches" (United Nations University, "Report of the United Nations University Expert Group on Human and Social Development, 10-14 November 1975" [Tokyo, 1975, mimeographed], p. 7 [para. 11]). On north-south dialogue, see Kinhide Mushakoji, "Daisan-sekai no seiji-gaku" [The political science of the Third World], in *Kōdōron igo no seiji-gaku* [Post-behavioural political science] (Japanese Political Science Association, Tokyo, 1976), pp. 159-182.

27. Michel Foucault proposes a new approach to the history of science which he calls "archaeological history" (*histoire archéologique*). The same approach may be used in studying the contending paradigms of an inter-paradigmatic dialogue. Cf. Michel Foucault, *L'Archéologie du Savoir* (Paris, 1969), pp. 232-255.

28. Cf. Jean Petitot-Cocorda, "Identité et Catastrophes (Topologie de la Différence)," in J.M. Benoist et al., *L'Identité – Séminaire interdisciplinaire dirigé par Claude Lévi-Strauss, Professor au Collége de France, 1974-1975* (Paris, 1977), pp. 109-156.

29. Cf. ibid., pp. 124-127.

30. Tokuryū Yamauchi distinguishes oriental thinking based on *lemma* from occidental thinking based on *logos. Lemma* concerns itself with the modalities according to which the human mind grasps reality rather than how human intellect reasons about it. Tetralemma is the basic structure of this approach, which provides the theoretical foundations for the "inter-dependence" (*pratiyasamutpāda*) worldview. See Tokuryū Yamauchi, *Logos to lemma* [Logos and lemma] (Tokyo, 1974). The lemmic approach is a breakthrough in view of the possibilities it provides for overcoming the static ontology of the West inherited from Parmenides. Cf. José Ortega y Gasset, *Historia como Systema* (7th ed., Madrid, 1975), pp. 34-45.

31. For an attempt to propose an alternative model to the means-end rational planning one by applying tetralemma, see Kinhide Mushakoji, "Control, Resistance and Autonomy: An Application of Complex Probability Theory," *Peace Research in Japan*, 1973, pp. 31-45.

32. This spiral process can be viewed as involving research, education, and action leading to more research, more education, and more action. Cf. Kinhide Mushakoji, "Peace Research and Education in a Global Perspective: Where Research and Education Meet," in Christoph Wulf, ed., *Handbook on Peace Education* (Frankfurt am Mein and Oslo, 1974), pp. 3-18.

33. A really representative international critical forum for inter-paradigmatic dialogues should be in close touch with the international arena where all the nations of the world are represented.

This is why a scientific forum within the framework of the United Nations, i.e., a United Nations University, can play a crucial role in international inter-paradigmatic dialogue. Cf. United Nations, *Introduction to the Annual Report of the Secretary-General on the Work of the Organization, 16 June 1968-15 June 1969* (Document A/7601/add.1) (New York, 1969); also United Nations University, "Report of the Advisory Committee Meeting on Human and Social Development Programme held at el Colegio de México, Mexico City, Mexico, 3-5 November 1977" (Tokyo, 1977, mimeographed), p. 4.

34. The conditions which should be fulfilled by the United Nations University in order to play its role in the contemporary scientific revolution are defined in the above-mentioned report in a way very close to the discussion of the present paper: (i) holism, (ii) openness to new forms of organization and modes of working, (iii) maximal decentralization of functions, (iv) creating the preconditions for creative research, (v) creation of a critical forum for the exchange of ideas from different cultural traditions, and (vi) continuing exploration of the dynamics of learning processes, and awareness of the educational dimensions of all United Nations activities (ibid.).