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Scaffoldings For Policy Theories: Context Sensitive Rationality

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SCAFFOLDINGS FOR POLICY THEORIES: CONTEXT SENSITIVE RATIONALITY

by

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ABSTRACT

Which rationality concept is adequate for policy theories? A Received View Rationality (RVR) concept is found in decision and policy theories. RVR is instrumental, formal and analytic (decomposing). The thesis that ideal RVR is adequate for policy theories can be defended either because RVR is context free rationality (CFR) and hence universally applicable, or because it is especially adequate for policy theories. The first defense is rejected as a corollary of an Arrovian Meta-Theoretic Impossibility Theorem (AMTIT). AMTIT claims that a context-free choice theory adequate for finite multi-dimensional choice structures is impossible. If at all, rationality can be theorized by a multitude of concepts each adequate for some context (or domain). The second defense is rejected following a detailed analysis of the current situation in the policy sciences literature. The case of the Strategic Air Command Basing Study is analyzed and insights are drawn from it concerning its rationality. RVR is not capable to account for the rationality of this case. The case involved a change in the investigated problem design of new objectives and alternatives and the emergence of a novel concept. Two families of extreme rationality concepts are articulated against the background of this case. Context-Free Rationality (CFR) which is an idealization of RVR, and Context-Sensitive Rationality (CSR) stand at opposing poles in terms of ontology, methodology and orientation. The notion of a practice is explicated. A practice contains cycles of deliberation, action and

product (these are called 'conduct') and results. Over and above such cycles there are superstructures of traditions and institutions. A heuristic is explicated in contrast to an algorithm along twelve dimensions. The ontology of CSR is practices; its methodology is heuristics; its orientation is synthetic-synergistic. The content of the appropriateness of CSR is inherently dependent on states of knowledge and thus it cannot be foretold. The normative force of CSR is related to its expression of that possible intervention of human reason with some particular practice by which the current potential for directing and controlling the practice is exhausted and at the same time a continuous effort is made to enlarge that potential. CSR captures the rationality of the case study and enables conceptualization of policies.

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> "If men are not always rational beings, they are the beings who are <u>sometimes</u> rational." (Wohlstetter, 1964, p. 131)

> "The 'rationality' here is of the shaping, groping reason. It is the rationality of the metaphor, not of the theorem. It is important to insist that this <u>is</u> rationality ... The rationality of creative hypothesis-construction is far broader, evidently, then is the logicality of prediction, generalization, justification, falsification ... creative human activity is by definition not rule-guided. And this is the simple reason why we cannot confine the rational to the logical." (McMullin, 1980, pp. 32-3)

> "Both policymaking and policy sciences need philosophic and intellectual underpinings ..." (Dror, 1986, p. 221)

1.1 Orientation

Ideas of rationality play a central role in various philosophical and scientific theories.[1] Ethics, epistemology, philosophy of science, philosophy of action, decision theory, economics, game theory, and policy sciences, among others, utilize and develop theories and concepts of rationality.[2] The vast variety of treatments of rationality prohibits surveying the whole field. This dissertation is no exception. It is submitted within the Program of Studies in the Foundations and Philosophy of Social Analysis and Management (PSAM). As such, it takes the realities of social analysis and management to constitute the raw material for philosophical reflection. This particular interest of PSAM guides the intellectual effort made here. It is focused on philosophical discussions and clarifications relating to one of the most important realities of social analysis and management -- the phenomenon of policies and policy making. Public policies stand at a focal point in our culture today. To say that we live in a policy saturated era is no exaggeration. Yet, as it is detailed in the chapters to come, the theoretical understanding of policies is still deficient. An effort is made here to contribute for the improvement of this situation. It is done by concentrating on the role which the concept of rationality has in the theoretical understanding and in the prescribing of policies.

In order to be relevant for the understanding of policies as a core part of social analysis and management, the philosophical reflection has to be grounded in the realities of the attempts to understand policies. Moreover, it has to be conducted using a conceptual apparatus which is accessible to policy scientists and practicians. Speculative philosophy, for example, may have produced a welter of relevant insight, but it is grounded in its own categories, and not in the realities of the current attempts to understand and make policies, and it is conducted within a conceptual framework which is unlikely to be accessible to policy scientists and practicians.

The framework of PSAM obliges to take these considerations into account. Thus, this dissertation grows out of a philosophical analysis of the current situation within the policy sciences. Because the prevailing ideas of rationality within the policy sciences build upon decision theory (as becomes apparent below), a considerable part is devoted to discussions of rationality within this framework. As a source for an alternative conceptualization of rationality, a case of a successful and influential policy analysis is studied. Some philosophical lessons concerning rationality are drawn from this case. Finally an alternative concept of rationality is articulated. It is argued to be adequate for policy theories. By this the dissertation as a whole is geared to the interests of policy scientists -- those who strive to understand that phenomenon of social analysis and management called policies -- by providing philosophical reflection and clarification. On the other hand, by being geared to those interests, some contributions to the philosophical theory of rationality are made possible.

The philosophical sources that are utilized in this effort are among the following: those relating to the prevailing concept of rationality, those helpful in the criticism of that concept, and those found helpful in the construction of an alternative concept of rationality. In other words, the specific viewpoint of PSAM, being geared to the interest of policy science, determines the pragmatic and opportunistic utilization of philosophical sources. It is the potential of philosophical elucidation for the theoretical attempts to understand and make policies, which is the acid test of the effort made here.

In the sequel the orientation of this dissertation is delineated in some detail.

1.1.1 The Main Question: One of the functions of a rationality concept (R-concept, for short) is the prescriptive function.[3] The R-concept which a theory uses provides it with a normative force. For any prescriptive theory, if its normative force is to come from its R-concept, then it is imperative that its R-concept should be adequate for the tasks of that theory. The main question (MQ, for short) to be discussed here is accordingly:

Which R-concept is adequate for (normative) theories of policies?

1.1.2 The Approach: The study undertaken here can be characterized as a philosophy of science treatment of theories of policies, especially normative theories (including policy analysis). As explained above, the character of PSAM constrains the approach taken. A meta-scientific examination is made of policy theories, in a way which can provide philosophical elucidation which is accessible to policy scientists and practitioners. In other words, theories of policies, which include one conceptualization of rationality or another, are taken as materials for philosophical reflection. This reflection examines the adequacy of those conceptualizations of rationality.

Three kinds of approaches to such a reflection can be discerned: natural history (or inductive), hypothetico-deductive, and logical reconstruction (or dialectical). In a natural history approach to our problem there are four distinct steps: (i) identifying policies independently of any particular R-concept, (ii) codifying the nature of policies in a theory or theories, (iii) analyzing those theories, and especially the roles (if any) of rationality, and (iv) explicating the emerging concept(s) of rationality. (Alternatively, the natural history approach begins with step (ii), but see immediately.)

This approach is unfeasible, because (i) is impossible. Policies can not be identified and characterized independently of some R-concept. This is seen clearly when the constitutive role of rationality is discussed in section 1.3.3. In a nutshell, the idea is that the R-concept accepted constrains what can be regarded as a policy. Suffice it to note that whatever policies are, they are intentional. As intentional they presuppose rationality. "[F]or as a matter of definition what is intentional meets standards of rationality ... [U]nless an interpreter can discover a rational pattern in the behavior of an agent, he cannot describe or explain that behavior as intentional action"[4] (Davidson, 1985, p. 90).

Although (i) is unfeasible, a natural history approach to MQ can begin with a modified step (ii). This time it says: (ii) Surveying existing theories of policies. Following (ii) may be an interesting project in the (current?) history of policy theories, but the end product of such an effort may not be an acceptable answer to MQ. It is logically possible that all the existing policy theories use inadequate R-concepts. Therefore, presenting an explicated R-concept extracted from existing policy theories as an answer to MQ is ill conceived.

The second approach, the hypothetico-deductive approach calls for presenting a theory (preferably in axiomatic form) and deducing implications from it which are put to test. Because the possibility of manipulating the relevant societal variables in order to test competing philosophical theories is quite meager (to say the least), the prospect of the hypothetico-deductive method for answering MQ are quite low.

The third approach, the dialectical[5] is adopted in this work. This approach begins with some base, and by criticizing that base it exposes significant factors and conditions which can serve as desiderata for the desired concept (or theory). This base is the historically given "received view". At our starting point the content of the adequacy desiderata of an R-concept for theories of policies is not clear at all. By criticizing the proposed base, desiderata of the type described above emerge. These criticisms amount to some search of the possibilities for conceptualization of rationality in policy theories. Of course, an appropriate choice of the base for the dialectic approach can facilitate this search.

1.2 The Base Concept -- The Received View Rationality (RVR)

The base concept, that R-concept by whose criticism the dialectical approach to answering MR proceeds, is an idealized concept of rationality termed Received View Rationality (RVR). Although many writers adhere to some, or all, of the component ideas of RVR, it is not presented as a representative of all the actual R-concepts in use in policy theories. Rather, it is presented as an "ideal type." It is presented as an option which (i) can serve, at least, <u>prima facie</u>, as an R-concept for theories of rationality, (ii) is recommended for this task by at least some of the writers on policy theories, and

(iii) has been elaborated theoretically and philosophically to a high degree. The criticism raised with respect to the possibility of RVR serving as an R-concept for policy studies produces desiderata for an adequate R-concept for policy theories.

1.2.1 Received View Rationality (RVR) Articulated: Three components theses comprise the R-concept which is called here 'RVR.' RVR is first introduced, then argued to be indeed a received view. The first component is the idea that reason is instrumental or instrumental rationality (IR). IR claims that rationality consists in the choice of a means for achieving some end such that (i) that end is given, and (ii) the alternative means for achieving that end are given, and (iii) there are no other given means, by whose choice that end would be attained either to a higher degree or more efficiently in terms of means, or both. The second component idea is the thesis that reason is formal. Reason is conceived as a calculating device which is capable to draw consequences from given premises, through the use of formal rules. Thus, reason can detect formal connections (which include connections within patterns of preference, or between means and ends, but not substantive truths). (In particular it cannot identify ultimate ends). The third component of RVR is the principle of analysis: that since reason operates on means-ends relations, a complex problem, where these relations are not easily traced, is decomposed to components, in which means-ends relations are traceable, and thus they are capable of being treated by reason, and then these components are recomposed. The principle of analysis is intended to extend the applicability of rationality to complex situations.

By being instrumental reason can only deal with means-ends relations; by being formal it can only do it by processing formal connections of those means-ends relations. By the principle of analysis it is supposed to be extendable to all complex situations (iterated decompositions, in one direction, and recomposition in the other will, hopefully, do the trick). Clearly there is here an ideal type, namely where rationality is completely formally specified. As a result of the combination of the above three components, rationality of this ideal type is context-free. For the ends and the alternative means are given to reason. The formal relations (over what is given i.e., ends and means) are independent from specific contexts. The principle of analysis provides a method which makes this processing of formal features of means-ends relations, universally applicable. The way reason works -- formal processing of instrumental relations -- is the same in all contexts. Thus, RVR, that R-concept which claims rationality to be instrumental, formal and analytic, is ideally a Context Free Rationality (CFR) concept.

Context Free Rationality (CFR) captures the RVR ideal; understanding it illuminates the western rationality tradition and the policy sciences literature in particular. Formal discussions of rationality in this thesis will focus on CFR. Insofar as this ideal is not achieved the discussions of rationality needs to proceed by informal examination of cases. This examination occupies the bulk of the tnesis.

Is RVR, indeed, a received view? As stated above (1.1.2) the method used in this work is not the inductive, natural history approach (to policy theories). Rather it is a criticism of an "ideal type" of an R-concept, which, hopefully may lead to an appreciation of the possibilities for constructing an R-concept adequate for theories of policies. Moreover, there is a muddle of issues, conceptions, views and attitudes in the policy sciences literature, and in and around decision theoretic and philosophical treatments of rationality, that makes it impossible to construct one representative concept which will do justice to all the available concepts. This is not surprising, and has to be seen, notwithstanding the long history of the subject, as an indication not only of divergent interests, but also of low degree of theoreticity of the subject. Nevertheless, it can be fairly said that to a large degree, RVR, as constructed here, is representative of ideas, which although each of them has many contenders, are quite prevalent in the literature of relevant areas.

Of the three component theses of RVR, the largest measure of consent is given to the idea that rationality is instrumental. IR can be traced in ancient philosophy (Glaucon's views on justice in Plato's The Republic;[6] Book III of Aristotle's Nichomachean Ethics[7]). IR is found in modern philosophy, especially in Hume,[8] and in social theory -- Weber's distinction between the rationality of ends and the rationality of means.[9] It is the corner stone of microeconomic theory[10] and a pillar of modern decision theory.[11] It is echoed in decision analysis and in policy theories.[12] It is one of the concepts frequently discussed in contemporary philosophy.[13]

The following citations convey the flavor of IR:

> "The Humean element of the theory is that 'instrumental' rationality is all rationality. The content of one's ultimate ends cannot be assessed as rational or irrational; rationality lies in adopting appropriate means, in an uncertain world to whatever substantive goals one may have. By instrumental rationality here is meant rationality in the pursuit of ultimate ends accepted as given." (Gibbard, 1983, p. 210)

> "... [T]hat form of rationality which seeks to discriminate among alternative actions by assessing their comparative tendency to advance or retard the achievement of the actor's goals or values [is called] instrumental rationality." (Tribe, 1973, p. 671)

> "Instrumental rationality is essentially the view that rational acts are ones that best accomplish the chosen ends or goals or the agent." (Macklin, 1983, p. 211)

> "[O]n the received view of rationality an actor seeks to maximize expected utility, the fulfillment of her preferences given her beliefs." (Gauthier, 1984, p. 474)

> "Policy analysis may be defined as the choice of the best policy among a set of alternatives with the aid of reason and evidence." (MacRae, 1980, p. 74)

The second component thesis of RVR is that reason is formal. This thesis can be traced to Hobbes.[14] It is one of the leading ideas of contemporary "cognitive studies".[15] The following citations are illustrative:

> "Ramsey's contribution was to interpret instrumental rationality as a kind of formal coherence among preferences and actions. The conditions of coherence are that one's preferences form an ordering, that one always does what one most prefers, and the like. On the Hume-Rasey

> view, in short, rationality demands no more than a formal coherence of preferences, in a way that can be expressed in a set of axioms." (Gibbard, 1983, p. 201)

The third component of RVR is the principle of analysis.[16] This principle is mentioned not in discussions of the concept of rationality itself, but in connection with applications of theories of rationality, such as decision theory. Of course, its classical formulation in modern philosophy is in Descartes On Method. It is mentioned explicitly, under the title of decomposition and recomposition in Howard's assessment of decision analysis, and similarly in Raiffa's textbook:

> "Central to the paradigm [of decision analysis] is the decomposition of a possibly uncertain, complex, and dynamic decision problem into the choices, information, and preferences of the decision-maker ... The process is ... one of decomposition and recomposition." (Howard, 1980, p. 6)

> "The spirit of decision analysis is divide and conquer: Decompose a complex problem into simpler problems, get one's thinking straight in these simpler problems, paste these analyses together with logical glue, and come out with a program for action for the complex problem." (Raiffa, 1968, p. 271)

The following passages, written by a policy scientist indicates that the ideas comprising RVR have an important place in policy theories.

> "The Received View on analysis was synthesized in

> the early 1950's at Rand and similar policy oriented "think-tanks." It is a conceptual compound that includes elements from operations research and management science, from microeconomics and decision theory, and a dash of social and behavioral science ...
>
> Under the Received View, ideal policy making, rational decision making, rational problem solving, and policy analysis are synonymous. There is a one-to-one correspondence between the stages of the policy process and the phases of analysis ...
>
> Underlying the Received View and the basic categories of analysis it defines -- goal alternatives, constraints, and criteria of choice -- is a deeper commitment to a teleological or "end-result" conception of policy making." (Majone, 1980, pp. 162-163)

These citations (which could be multiplied easily) show that the requirement put above for an ideal-type R-concept, namely, that it can serve at least prima facie as an R-concept for policy theories, that it is recommended for this task at least by some writers on policy theories, and that it has been elaborated both theoretically and philosophically, are all met.

One more remark before we continue. Although there are adherents to each of the three theses comprising RVR, there are opponents to each of them. To gain a better perspective on RVR, some of the responses to RVR are scanned in 1.4 below following a discussion of the criticizability of R-concept in 1.3, immediately.

1.2.2 RVR and Decision Theory: Decision theory[17] is taken by many as "the best framework currently available for discussing the rationality of actions" (Follesdal, 1982, p. 306). The R-concept used by decision theory is RVR (with the necessary adjustment for the so-called "risk and uncertainty" conditions to be discussed below). Moreover, some discussions in later chapters, especially Chapter 2, use the framework of decision theory. Some rudiments of the decision theoretic framework are, therefore, briefly reviewed to facilitate later discussions.

The main notions of decision theory are choice and consequence (or outcome). A decision problem is conceived as a choice problem. A choice is the selection of a subset from a given set (of some objects). Decision problems are usually about courses of action. The set from which some subset is to be selected is, accordingly, a set of courses of action (also called "alternatives" or "acts"). A decision problem is resolved when some course of action is adopted. A decision, i.e., the adoption of an alternative leads to some definite consequences (or outcomes). The choice among the alternatives is to be made according to their consequences. The consequences are evaluated in the light of some given goals. These are the agent's (the decision maker's) goals. Consequences which are evaluated higher than others, in terms of these goals, are preferred than the others. Accordingly, alternatives which lead to consequences which are preferred than some other consequences, which are due to some other alternatives, are preferred to those latter alternatives.

Behind the treatment of decision problems in decision theory there is a canonical representation of decision problems. Under some conditions (to be discussed immediately), this canonical representation is only implicit, while under other conditions its explicit use is necessary. The canonical representation is the so-called payoff matrix.

> "A payoff matrix is simply a rectangular array whose rows denoted $a_1, \ldots, a_i, \ldots, a_n$, correspond to the alternatives that are available to the decision maker, and whose columns, denoted $s_1, \ldots, s_j, \ldots, s_m$ correspond to the possible states of nature. The entries of the payoff matrix are the outcomes, or consequences, resulting from a selection of a given row and column. Thus, the O_{ij} entry of the table represents the outcome obtained when the individual chooses alternative ai while nature, so to speak, "chooses" state s_j." (Tversky, 1970)

Decision theory attempts to find guides for the resolution of decision problems. A guide of this sort is expected to lead to the adoption of an alternative when one is faced with a decision problem. Decision theory provides such guides in the form of decision rules for some classes of problems. These decision rules are sometimes said to be, or express, maxims of rational behavior, or rational choice, or, simply, of rationality. Relative to the payoff matrix three major classes of decision problems can be distinguished (Luce and Raiffa, 1957, Ch. 2; Tversky, 1970). This is done according to the agent's knowledge of the states of nature. For each class decision theory suggests a standard or some standard decision rule(s).

The first class is the so-called certainty conditions. Under certainty the agent knows, with certainty, which state of nature obtains. Thus, he knows which consequence will result from each of the n possible alternatives. The matrix is degenerated into a single column. (Because of this degeneration, the canonical representation is usually only implicit under certainty conditions). The standard decision rule for the certainty conditions is the maximization of preference. An alternative is to be chosen when there is no other which is higher in the order of preference (i.e., when the consequences of no other alternative are higher in the order of preferences than its own consequence).

The second class is the so-called risky conditions. Under risk the state of nature which obtains is not known. The knowns are the possible states of nature and the associated consequences (for each pair of an alternative and a state) together with the probability distribution of the possible states. The standard decision rule for this class of problem is the maximization of expected utility (MEU) rule. MEU says that the chosen alternative should be one whose expected utility (i.e., the probability-wise weighted average of the utilities of the possible consequences, where the utilities are values of real-valued functions defined over the consequences which preserve the order of preferences among the consequences, and is unique up to a positive linear transformation) is at least as high as that of any other alternative. Decision theory presents various sets of conditions (or axioms) which guarantee the existence of utility functions with the desired properties.

The third major class of decision problem is the so-called uncertainty conditions. Under these conditions the only knowns are the possible states of nature and the consequences (associated with pairs of an alternative and a state). In contrast to the conditions of certainty and risk, the use of the payoff matrix is essential for the formulation of decision rules under uncertainty. Several decision rules for uncertainty conditions have appeared in decision theory. Among the better known rules are the maximax, maximin, minimax, Hurwicz's criterion and insufficient reason.[18] The maximax rule is an optimistic rule. It (tacitly) assumes that the best will happen, whatever is done by the agent. The chosen alternative according to maximax is an alternative whose maximum (utility value) across the possible states in maximal among all the given alternatives. Maximin is a pessimistic rule. It (tacitly) assumes that the worst will happen. If this is the case, then it is reasonable to choose an alternative whose minimum (utility value) across states is maximal among the (minimal values of the) alternatives. When the consequences are represented in terms of loss (or negative utility) instead of utility, then the same pessimistic (or conservative) attitude leads to the minimax rule. According to the minimax rule a chosen alternative is one which minimizes (among the alternative) the maximum loss due to an alternative (across the states). Hurwicz's criterion attempt to combine the pessimistic and optimistic attitudes. Let q be a number between 0 and 1. For each alternative, a_i, let m_i be the minimum and M_i the maximum of the utility numbers associated with its possible consequences. The q-index is defined as $qm_i + (1-q)M_i$, for each a_i. The chosen alternatives is one with maximum q-index. The criterion based on the "principle of insufficient reason" give equal probability to all the possible states, $s_1,\ldots,s_m$. The decision rule is to choose an alternative whose averaged utility over the possible states (the sum of these utilities divided by the number of states) is maximal.

There is another approach to decision problems under uncertainty. It is to intuit subjective probabilities (i.e., degree of belief) over the states. Once there is such a subjective probability distribution, one proceeds as under risk. The decision rule in this case is the maximization of subjective expected utility. The initial assignment of probabilities is subject to revisions in adjustment to accumulating evidence according to a formula known as Bayes Rule (or Formula).[19]

Decision theory is presented axiomatically. In the description above, which may be seen as the stage of clarifying the explicandum,[20] the criterion for rational action, i.e., choosing an alternative whose expected utility is maximal, is justified on the basis of the above mentioned considerations (and their elaborations). In the stage of building the explicantum, which is constructing an axiom system, the criterion of maximum expected utility (MEU) justifies the axioms, in the sense that it is a prerequisite for any adequate axiom system, that this criterion is derivable from the axioms. In addition to this prerequisite from the axiom system as a whole, each axiom is required, if it is not stating a structural condition,[21] to express a trait of rationality, such as the transitivity of the preference relation over outcomes. This may be a controversial claim. Usually it is claimed that "a Bayesian ... simply wants to act in accordance with a few very important rationality axioms: and he knows that this fact has the inevitable mathematical implication of making his behavior equivalent to expected-utility maximization" (Harsanyi, 1977b p. 381).

To complete this snap-shot of decision theory some additional branches of it should be mentioned. The theory which is described above deals with decisions of an individual. A branch of decision theory deals with group decision making.[22] A central concern of this theory is to inquire into the conditions under which a group decision can be connected to preferences and decisions of the members of the group. The most important result is an impossibility theorem due to Arrow (1951) which is discussed in Chapter 2. A theory of decisions when the final outcomes depend also on decisions of other agents is the so-called theory of games.[23] Several other branches of theories are regarded sometimes as belonging to decision theory in an extended sense. These include e.g., micro-economics and operations research.[24,25]

Reflecting over the rationality concept of decision theory it can be seen that it is a quasi-logical concept. Two components are involved. First the consistency or coherence requirement of preferences; to act rationally the agent's preferences, according to which he is supposed to act, must cohere. A standard requirement is that of a weak-order (i.e., transitivity and completeness) of preferences. Second, the action chosen must cohere with the agent's (coherent) preferences, in the sense that there is not an action which he prefers over the chosen one. As explained, in probabilistic contexts (i.e., under risk or uncertainty) the MEU criterion ensures just this.[26]

To recapitulate: Decision theory extends RVR to risky and uncertain conditions. The basic character of RVR is not changed by this extension. It remains instrumental, formal and analytic. Its requirements have a quasi-logical character of securing coherence among the agent's preferences and between his choice and his preferences. From now on RVR is used to cover also probabilistic contexts.

The discussion in this chapter is not meant to say that the only available concept of .ationality is instrumental rationality. It is meant to say that RVR is a good bench mark to begin the search process for an adequate R-concept for policy theories. It is a good bench mark because it is quite an articulated concept, grounded in economics, decision theory and philosophy and claimed by many to be adequate for policy theories, either by an explicit declaration, or by quiet deed.

1.3 Criticizability of an R-concept

Granted that some R-concept, like RVR is the accepted R-concept. Can this R-concept be criticized? If an R-concept is not ciriticizable once it is accepted, then this is a serious drawback. For even if its initial acceptance "was rational" its continued acceptance cannot be defended as rational because it cannot be criticized and judged as irrational. In such a case it is quite doubtful whether it is justified to call its initial acceptance "rational." It seems that the rational ciricizability of an R-concept is a necessary condition for its rational acceptance. The following discussion shows that securing criticizability of an R-concept is not a simple matter, that an obvious way to respond to this challenge has a high price of fragmentation within the notion of rationality, that even in this way some R-concepts tend to resist criticizability, and that in particular, RVR tends to be self-immunizing against criticism. It appears that the criticizability of the R-concept on the basis of accumulated experience is a desideratum for any adequate R-concept.

1.3.1 The Rational Critic Problem: Suppose that any R-concept, if it is an appropriate one, is equally appropriate across kinds of situations, such as communication, argumentation, belief, decision and action. Suppose that there is an accepted R-concept with this property. Any rational criticism of this concept has evidently to comply with it, otherwise it would not be rational. But then it cannot criticize the accepted R-concept, simply because it complies with it. For if the R-concept is not appropriate, then the criticism which complies with it is not rational. If it is assumed that the criticism is rational, then the accepted R-concept with which it complies, cannot but be regarded as appropriate and rational. Thus any attempt to rationally criticize such an R-concept is self-defeating.

Without a solution to this problem, an attempt to (rationally) criticize an accepted R-concept is futile. Either you agree with the accepted R-concept, or else you do not have a way to negotiate rationally your opinion. R-concepts seem to be either accepted (by faith?) or overthrown (by another faith?) but not open to rational criticism.[27]

1.3.2 Fragmented Rationality: One of the deep-rooted strategies used in our culture for responding to difficulties, intellectual and otherwise, is that of division; divide and conquer! When this analytic (i.e., decomposing) strategy is applied to the challenge of the Rational Critic Problem the result is that rationality is divided according to different areas of application, such as those mentioned above. If we are lucky then one of these R-concepts may be found common to all the others. Such an R-concept relating primarily to one of those areas may thus serve to judge the other R-concepts. The distinguished layer of rationality is that of communication and argumentation. Rational criticism of any R-concept, suitable for any area, is done by way of communication and argumentation. If norms of consistency and coherence, which pertain to "deduction, induction, reasoning about how to act, and even how to feel, given other attitudes and beliefs" (Davidson, 1985, p. 92) are not kept, together with norms of correspondence such as that an interpreter should interpret agents as "having beliefs that are mostly true," then no thought or action is possible.

When an R-concept is criticized and defended, a meta-level viewpoint is involved. In it the norms of rationality of communication and argumentation must be kept, otherwise there is not any criticism and defense. These norms are the joint contents of the R-concept of the opposing parties. They are part of "a very large shared background of beliefs and values" without which "differences, like agreement" (Davidson, 1985, p. 91) cannot be understood. A basic layer of rationality is, thus, the rationality of communication and argumentation. When this kind of rationality is present, a necessary condition for rational criticism of rationality is fulfilled. This basic and presupposed layer is common to interacting R-concepts.

When the rationality of communication and argumentation is kept a basis for rational discussion of different R-concepts is provided. For rational discussion of the rationality of, e.g., an R-concept which pertains to the area of decision and action, can now be held regardless of the specific content of that R-concept. But there is a high price for this step. Rationality becomes fragmented. Instead of a unified idea of rationality we have now several concepts of rationality, e.g., the rationalities of communication, argumentation, belief, knowledge, decision and action. Thus, a new problem arises as a result of using the strategy of division towards problems of rationality. This new problem is whether reunification within rationality is possible. A strategy for unification used in many areas is that of reduction. Thus attempts to reduce various classes of R-concepts to one class or another can be found. For example, Popper (1963) gives exclusive role to the rationality of communication and argumentation,[28] while Elster in his review article (1982) gives prominence to the rationality of "states of mind" and the rationality of behavior is reduced to it.[29] Anyhow, the reunification of rationality becomes an issue deserving a solution when the strategy of division is adapted.

1.3.3 Criticism Still Resisted: Dividing rationality and identifying the rationality of communication and argumentation as the common R-concept is not enough to secure criticizability. To see this the various roles of rationality are discussed briefly.

Two roles, or functions of rationality are widely recognized and discussed. These are the descriptive (empirical) and the prescriptive (normative) roles.[30] Arrow (1951a, p. 646) gives a succinct description:

> "[A] rational theory always has a dual interpretation. On the one hand it may be taken as a description of reality to the extent that individuals really are consistent in the sense assumed. On the other hand, it may be taken rather as a normative theory which prescribes what individuals ought to do."

Philosophers not only recognized these two functions but some of them have found it an intriguing problem that the one and the same R-concept can have both these two functions. As Leach (1977, p. 393) puts it explicitly with regard to RVR:

> "How is it that rationality theory, as derived from classical economics to mean something like efficient goal-directed behavior, serves the dual function of prescribing conditionally what behavior ought to be and also of describing predicting, and explaining actual behavior?"

In addition to the descriptive and the prescriptive functions, there are two functions: the ontological (or constitutive) and the epistemological (or meta-theoretic). It is because of those two functions and especially the epistemological one, that some R-concepts resist criticism.

The ontological function of R-concept concerns the determination of the entities which may be predicable as a rational. Any theory constrains the class of entities which may or may not be predicated by the terms of the theory. Thus, according to a standard interpretation of classical physics, the class of mass-points is the class of those entities which may be predicable by terms like 'mass', 'force', 'energy' etc. The layer of theory which determines the class of entities, or individuals which are predicable by the terms of the theory -- its state-variables and their derivatives -- is its "systematic ontology" with or without the relevant "abstract mathematical structures"[31] (Hooker, 1977, p. 13). That the state variables of position and momentum (and their derivatives) are attributable to mass points is determined by the systematic ontology together with the relevant abstract mathematical structures used.

The ontological function of RVR requires that the entities which may be predicable as rational are choices. The descriptive and normative functions of RVR (on the level of "general theory") requires that only those choices are rational which are instrumental choices maximizing a criterion which expresses efficiency in the attainment of some goals.

Any elaborated theory of rationality has to conform to the accepted epistemology (meta-theory). But rationality has a role in the meta-theory too.[32] The accepted R-concept provides the accepted epistemology with the normative force it needs with respect to theories, including the theory of rationality. Thus, the epistemological function of an R-concept is to direct the scope of the theory of rationality, the relations, especially priority relations, to other theories and the parameters or attributes of rationality to be elaborated in the theory of rationality itself. The direction of the relations of influence between the theory and its meta-theory are not unilateral (from the meta-level to the systemic level) but bilateral. The epistemology can be criticized on the basis of the theory. But once a concept of rationality is given a meta-systemic standing (as a component of a relevant epistemology) it exercises a normative force towards theories of rationality which can be accepted. Thus an R-concept has also a (meta-systemic) epistemological role or function. R-concepts can differ, for example, in the latitude which they allow for a variety of theories of rationality. Some may demand just one kind of theory which can conform to an epistemology which contains them. Others may be more lenient.

For some R-concepts there may be strong reinforcement between the epistemological and the constitutive roles. If some particular R-concept, in its epistemological role, allows for only one theory of rationality to be accepted, then the constitutive role of this R-concept is reinforced. For now, as long as that R-concept is retained, only those individuals which stand in the appropriate relation of being predicable by that R-concept, can be entertained for reference in the theory of rationality.

Because of the normative force exerted by its epistemological function an accepted R-concept tends to resist criticism. Failure involving its application may accumulate, but its epistemological function tends to require that this R-concept should be the accepted one. Thus, criticisms may be deflected.

1.3.4 RVR Tends to be Self-Immunizing Against Criticism: Because of its epistemological role, RVR on the level of general theory, tends to resist criticism. On the level of general theory it claims that choices are rational only if they are instrumental choices maximizing a criterion which expresses efficiency in the attainment of some given goals. On the level of epistemology it determines that any theory of rationality should construe rationality in this way, i.e., as rational choices which are but instrumental choices maximizing a criterion, etc. Any criticism of RVR on the level of general theory (i.e., its descriptive or prescriptive functions) tends to be deflected because of its epistemological role which determines that it should be so construed and not otherwise. Thus, RVR tends to become self-immunizing against criticism.

1.3.5 Rational Criticizability of Rationality: Because of the epistemological function of R-concepts the rationality of communication and argumentation is not sufficient to secure criticizability of an R-concept. Two routes seems to offer some hope. First, if we are lucky then the accepted R-concept can be criticized by internal criticism. It is a criticism such that (i) its formal aspects are governed by the norms of the rationality of communication and argumentation; (ii) the meta-systemic claim of an R-concept, i.e., that any rationality theory should be in conformity with it is rebutted by it, and; (iii) it is done according to the strictures of the criticized R-concept. Internal criticism is ultimately a criticism in terms of coherence, i.e., it satisfies reductio or equivalent principles. Hence, it can be argued to be within the logic of (i).

But an R-concept may be internally consistent yet leads time and again to failures when applied. Then perhaps the second route may be of some help. According to it a suitable meta-level should be located from which the accepted R-concept can be criticized. This meta-level may be located by some dialectical process of confronting the accepted R-concept with some contenders, or by some other way. By this an ascending, if not unbounded, hierarchy of meta-levels may be required to criticize and judge the lower levels and R-concepts.

As it happens, we are lucky and the accepted R-concept, namely RVR, can be criticized by internal criticism. Chapter 2 develops such criticism which shows that the universal applicability assumed of RVR is impossible for the case where its universal applicability results from its being context-free. Chapter 3 shows that it is not especially suitable for policy issues. An attempt is made in Chapter 5, where an alternative R-concept (or more precisely, a family of R-concepts) is articulated to build the property of criticizability on the basis of practical experience into the alternative R-concept.

When an alternative R-concept is used in discussions of policies, whether explicitly articulated or not, but without prior internal criticism of the accepted R-concept, there are only a few chances that this effect will be convincing. Thus, it becomes understandable that innovative work on policy making (e.g., Vickers, 1965, 1968; Hooker, 1980, 1982, 1983) have had only meager effects. Whether or not they are brilliant, these alternatives are not rationally convincing when a prevailing R-concept, like RVR, is accepted, because they are not based on internal criticism. The appeal of a new alternative has to confront the dictates of the meta-systemic role of the prevailing R-concept. Usually the meta-level decree wins.

1.4 Responses to RVR

RVR is introduced above (1.2) as an idealized R-concept. It is not claimed to represent all the R-concepts introduced explicitly or used implicitly in policy theories or in philosophical discussions of rationality. Moreover, there is some awareness among some writers on policies that RVR needs some modification or a more radical alteration. Without any pretensions of comprehensiveness -- which is not required in works done in the dialectical approach, as in this work -- a variety of views about rationality in policy theories can be presented in a useful way as responses to RVR. The list of these responses provides a better perspective on the state of rationality discussions in the policy sciences literature and on the place of RVR among other R-concepts. The fact that a variety of R-concepts can be presented as responses to RVR shows the central place is occupied by this R-concept.

1.4.1 RVR and Other R-concepts: Various attitudes and positions concerning rationality which populate the policy sciences literature can be construed as responses to RVR.

(1) Retain RVR, with or without some recognition of difficulties in carrying it into practice (e.g., Mood, 1983, pp. 2-6).

(2) Constraining RVR because of (i) limitations on individual (human) cognitive capacities (Simon, 1945); because of these limitations individuals can exercise no more than "bounded rationality" with the result that the maximization requirement of IR is substituted by a "satisficing" requirement (i.e., finding a "good enough alternative"), and (ii) limitations on both individual and organizational cognitive opportunities (i.e., capacities and available resources) (Lindblom, 1959, 1965): As a result of these limitations ends and means are not strictly separated, analysis is strictly limited in scope and iterative, and considerations of political acceptability take a major role in testing the goodness of a policy. What can be hoped for are incremental improvements and not a comprehensive solution.

(3) Reconstruct the process by which RVR is put into practice; instead of a one-shot decision, sequential decision processes (Klein and Meckling, 1958) are proposed for policy making (Etzioni, 1968), which may incorporate the recognition that a meta-level is required (Simon, 1951) for determination of the policy-making process itself (Dror, 1968), which may include a separate stage ("megapolicy") for determining the boundaries, i.e., the institutional setting, of the policy making process (Dror, 1971; Gershuny, 1978).

(4) Exchange the perspective of RVR: Instead of being a prospective concept, like RVR, rationality is taken to be, wholly or partially, a retrospective concept. In other words, rationality is equated with rationalization. This is so because only with

regard to the past, the strict informational requirements of IR can be satisfied (Weick, 1969, p. 39; Wildavsky, 1979, pp. 135-140).

(5) Trade rationality for persuasion: If rationality is, anyhow, severely constrained, and if, at least sometimes, it is nothing but rationalization, and if scientific methodology recognizes a place for persuasion, and if scientific methodology justifies retaining accepted views, in some circumstances, in the face of negative evidence (e.g., Lakatossian methodology), and if political acceptability is the ultimate test, and if the impact of rational arguments is too slow, then put persuasion at the forefront and push rationality to the backstage. This move is taken in Majone (1980).

(6) Dynamize it (even if by this rationality virtually disappears): RVR has a static character. When an objective is reached, the problem disappears. Life is seen as a succession of separate problems calling for distinct decisions. Instead of retaining some version of this problematic static concept, dynamize it! Instead of talking of solving separate problems which arrive in a succession, by trying to reach some "given" (how?) objectives, start talking about maintaining a balance of relationships extended in the time dimensions (even if by this rationality isout of sight). Some of these relationships are metabolic (self-maintaining) some of them functional (producing whatever is supposed to be produced), some of them internal, others external, some self-set, others imposed. Particular importance is given to

the (re)setting of the norms towards which the balancing effort is directed. Goals are secondary and derived from these relationships. This line is taken by Vickers (1965, 1968).

(7) Assign rationality to an observer: Rationality is irrelevant to a multidimensional complex system; such a system only seeks to survive. "Rationality is a label attached by the observer to behavior which is competent to survive" (Beer, 1963, p. 88).

(8) Declare a "concept-hunt": If IR is shown to be deficient in the policy area by a series of arguments (showing that it reduces various dimensions of a problem into one dimension -- usually monetary -- and by this it may mistake the underlying structure or "global" feature of the problem; that it is insensitive to the process and takes notice only of end results, even when the process itself is (among) what matters; sometimes "the very identity of the choosing individual or community" is at stake, but instrumental methods can be applied when there are given ends and given objectives), and if it becomes clearer that what is required is some concept of rationality, which will explicate the normative force relating to the self-forming, or constitutive, aspects of decisions, and if it seems that finding such a concept is "several lifetimes" away from us, then declare a concept-hunt, i.e., that a concept of constitutive rationality is wanted, so that these several lifetimes will be spent in a shorter period. This is Tribe's (1973, 1972) view.

1.5 Scaffoldings

Stepping onward along trails of searches and argumentations may lead to quick-sands, dunes or marshlands. If we are lucky, we may hit upon some relatively more stable grounds, grounds which can serve to further the searches. These relatively stable grounds are the scaffoldings. Looked forward they are hoped to be knowledge. Looked backward they are known to be at best, only scaffoldings. Scaffoldings for building other scaffoldings, hopefully more enriched, more enlightened, more fruitful, more satisfying (for the moment), but scaffoldings nevertheless. Optimistically we look forward. Pessimistically we look backward. Realistically we appreciate that using scaffoldings to erect an improved scaffolding is the kind of progress that can be achieved. Those who dare to declare that they are engaged with the "foundations" (presumably of a permanent structure) are prone to be found concentrating on their cherished constructions at the neglect of the relevant "soil-engineering." If we are lucky, it is scaffoldings that we may find, scaffoldings for scaffoldings.

1.5.1 **The Trail of Argumentation:** The skeleton of the main argument of this work is rather straight forward. There is a prevailing R-concept, namely RVR, which is historically given. Any search for an R-concept which is adequate for policy theories has to consider RVR as a candidate for this looked for concept, if it is to be relevant for the policy sciences. The thesis that RVR is adequate for policy theories (called Thesis 1 in Chapters 2 and 3), can be defended in two ways. Defense 1 says that Thesis 1 holds because RVR is context-free and hence universally applicable. Defense 2 says that Thesis 1 holds because of reasons specific for the policy context and policy theories. Note that there is in principle an intermediate position according to which RVR is universally applicable in spite of not being fully formal and hence not context-free. Defense of this view would require special argument to accept universal applicability in the absence of formal proof. In this thesis positions of this sort are not pursued.

Defense 1 is rejected in Chapter 2 by an argument which shows that a context-free R-concept is impossible. Defense 2 is rejected in Chapter 3 by both a philosophical argument about policy theories which incorporate RVR, and by a detailed analysis of the situation in the policy sciences literature. If RVR is rejected, where is one to look for an alternative? Again to retain the relevance for policy scientists and practitioners a case of a successful policy analysis is studied in Chapter 4 in order to draw philosophical lessons about the R-concept behind it. In Chapter 5 this incipient R-concept is refined by the articulation of the Context Sensitive Rationality (CSR) concept, which is articulated in contrast to Context Free Rationality (CFR), which is an extreme version of RVR. It is argued that indeed CSR is an R-concept; that it captures the rationality of that case study and that in contradistinction to RVR, it enables a conceptualization of policies.

1.5.2 Scaffolding for Policy Theories: To find an R-concept which is adequate for policy theories, two complementary efforts are made. The first searches for results in the general theory of rationality, which can be used in the search for that R-concept. The second looks for materials directly related to policy theorizing and analysis, which can serve as background, reference, and test grounds for both the general results and looked for R-concept for policy theories. Thus, this work can be read in two complementary ways. First, it can be read as an essay in the general theory of rationality which uses policy analysis and theorizing as a benchmark and touchstone. The second way is to read it as an investigation into a central issue in the policy sciences and their philosophy, namely, the articulation of an R-concept which is adequate, in ways yet to be discussed, for policy theories. It is an investigation which necessitates inquiries into the philosophical heights of the theory of rationality and into the practical plights of analyzing for and making and implementing of policies.

It seems that some scaffoldings (as described above) have been hit upon in this work. Some of the these scaffoldings are along the trail through the theory of rationality, some along the trail through policy studies. The followings are among the noteworthy scaffoldings.

(a) Concerning rationality in general:

(i) An explication of the meta-theoretic nature of Arrow's (1951, 1963) celebrated Impossibility Theorem. This is done by establishing an Arrovian Meta-Theoretic Impossibility Theorem (AMTIT). AMTIT shows that some conditions which are necessary for context-free choice theory which is adequate for finite multi-dimensional choice structures are contradictory. They are shown to be contradictory because the conditions of Arrow's Impossibility Theorem are derivable from them (Chapter 2).

(ii) AMTIT shows that there is an unbridgeable gulf between rationality as a formal ideal and rationality as a precisely constructed concept or theory. This holds not only for the rationality of choice or action, but also for the rationality of belief. The various explications offered of the rationality of beliefs can be seen as attempts to specify some choice functions which select rational from non-rational beliefs (see Sen, 1982c).

(iii) That there must be a multitude of R-concepts each of which is adequate for some associated domain (where a domain is a class of contexts which may be singleton) (Chapters 2, 4 and 5).

(iv) The articulation, on the background of the case study presented in Chapter 4 of two extreme R-concepts, CFR and CSR. Context-free rationality (CFR) takes to the extreme the prevailing R-concept, its ontology is separable instrumental choices, its methodology is heuristic, and its orientation is integrative-synergistic. (These terms will become clearer in Chapter 5 where the two R-concepts are articulated.)

(v) The discussion of the dimensions of sensitivity to the context of CSR. Many facets of sensitivity to the context can be exhibited. In a concrete case some combination of these is manifested (Chapter 5).

(vi) The triad relation between an R-concept, a method and a domain such that the R-concept justifies a method which systematizes a domain which is rationalized by that R-concept (Chapter 4 and 5).

(vii) That the content of the appropriateness of a method (i.e., its normative force) is inherently dependent on states of knowledge, in the relevant practice, and thus it cannot be foretold or fore dictated (Chapter 5).

(viii) That two kinds of heuristics can be distinguished, instrumental vs. self-directing heuristics. The second kind has hardly been identified and discussed (Chapter 5).

(ix) That the sense of appropriateness of a CSR-concept is that the particular concept expresses that possible intervention of human reason with some particular practice by which the following two ensue; (a) human reason's potential for directing and controlling that practice is exhausted, and (b) human reason persistently strives to enlarge this potential by absorbing required supplementation from the context (5.1.5.5).

(b) Concerning the study of policies in particular:

(i) A philosophical argument showing that RVR, or RVR based theories, undermines some adequacy requirements which are not theory specific. These include (1) criticizability of the R-concept on the basis of experience; (2) possibility for conceptualization or theoretization of policies; (3) capability for handling sensitivities to organizational factors, in case it is shown that policies are sensitive to such factors; (4) capability for handling all kinds of uncertainties that may be relevant to policies (Chapter 3).

(ii) The analysis of the situation in the policy science literature which shows that this situation echoes the philosophical argument. In particular, policy failures, which are common and recognized to be so, are regarded as due to poor implementation. They are not seen as resulting from possible inadequacies in the R-concept itself. Moreover, some writers provide detailed examples which show that policy studies which are based on RVR do not succeed. Some writers also recommend and carry measures that outstep RVR. Nevertheless, RVR is repeatedly presented as the R-concept which is appropriate for policy theories. This complex seems to be an instance of what Feyerabend has diagnosed as "a conservative ideology and progressive practice."

(iii) The exposure of the method taken in a successful case of policy analysis, and the specification of the major differences between this method and the recommendations of RVR.

(iv) An argument which shows that RVR cannot account for the method of this case for logical reasons.

(v) An argument which shows CSR can account for the rationality of that case study.

(vi) An argument that CSR enables a theoretization of polices as the product phase of a self-referring practice which has a recursivity property. This conceptualization of policies is free of the difficulties which plague RVR -- based attempts at such conceptualizations, and it answers the desiderata specified in (i) above.

NOTES

(1) McClennen (1983, p. 335) opens his critical survey by tracing ideals of "rational approach to social, political, economic, and ethical policy" in the writings of Plato, Hobbes, Kant, Hume, and Bentham. He reviews the current literature of public choice theory. This theory intersects the boundaries of economics, philosophy, political science, the law, and sociology. Elster (1982, p. 111) remarks that "[t]he 1970's have seen an explosive growth in the philosophical analysis of rational behaviour, rational beliefs and rational choice."

(2) For example the following: for ethics -- Frankena (1983), Brandt (1983); epistemology -- Audi (1985); philosophy of science -- Hooker (1982), Siegel (1983); philosophy of action -- Follesdal (1982); decision theory -- Luce and Raiffa (1956), Freehling (1984); economics -- Arrow (1971); game theory -- von Neumann and Morgenstern (1947), Harsanyi (1977); policy science -- Dror (1968) (1983).

(3) See Leach (1977), and below, section 1.3.3.

(4) Davidson (1985), p. 90. See also Freehling (1984), p. 182, "[R]ationality is a presupposition of the intentional stance."

(5) The sense of dialectic used here has some similarities to the 'reflective equilibrium' used e.g., by Rawls (1971, pp. 20-21).

(6) See McClennen (1983), pp. 337-339.

(7) "We deliberate not about ends but about means ... They [a doctor, a statesman] assume the end and consider how and by what means it is to be attained, and if it seems to be produced by several means they consider by which it is most easily and best produced ..." (Nichomachean Ethics, Book III: Ch. 3 1112b).

(8) Hume, A Treatise of Human Nature, Book II, part III, section 3.

(9) Turner (1986).

(10) Hahn and Hollis (1979), p. 4.

(11) von Neumann and Morgenstern (1947).

(12) Keeney (1982); Quade (1975); Tribe (1973).

(13) Elster (1982).

(14) Hobbes, Leviathan, Part I, Chapter 5, [18]: "When a man Reasoneth, he does nothing else but conceive a sum total, from Addition of parcels; or conceive a Remainder, from Subtraction of one summe from another ..."

(15) Putnam (1985, p. 143): "The first dogma of the High Computationalist Church, as represented by Fodor, pictures the mind as "computing" in a formalized language with a classical or "Fregian" quantificational structure."

(16) A penetrating discussion of the role of the principle of analysis, and of instrumental reason, in a major school of modern philosophy is in Unger (1975).

(17) The literature of decision theory is vast. The following are illustrative examples. The formal aspects of "mainstream" decision theory are covered in Fishburn (1968, 1970, 1972, 1981); Psychological factors are covered in Edwards and Tversky (1968) and in Kahneman, Slovic and Tversky (1982); Philosophical issues are discussed in Davidson, McKinsey and Suppes (1956), Davidson and Suppes (1957), Suppes (1960, 1981), Leach, Butts and Pearce (1973), Hooker, Leach and McClennen (1978), Freehling (1984); Economic aspects in Arrow (1971); and much more. The classics of decision theory are von Neumann and Morgenstern (1947), Ramsey (1926), De-Finetti (1936) and Savage (1954).

(18) For a discussion of these criteria see, e.g., Luce and Raiffa (1957, Ch. 13).

(19) The Bayesian approach, as it is called, was initiated by Savage (1954). It has exercised a continual influence in the philosophy of science, e.g., Harsanyi (1985). Critiques of the Bayesian approach includes, Tversky (1975), Dreyfus and Dreyfus (1978) Sowden (1984). The Bayesian model is regarded by some philosophers "as the most important and developed theory of rationality proposed in recent years" (Suppes, 1981, p. 85).

(20) According to Carnap (1968) there are two stages in an explication of a concept. In the first stage, the explanandum is clarified, in a non-formal way. In the second stage, the explicatum is constructed formally. It has to satisfy four requirements of (i) similarity to explanandum, (ii) precise characterization, (iii) fertility, (iv) simplicity.

(21) Structural axioms, or conditions are discussed in Suppes (1956, 1960, 1980), Fishburn (1968). "Intuitively, a structure axiom, as opposed to an axiom of pure rationality, requires that some special features of the environment be present and that they do not impose a constraint on the rationality of the decision maker that must be satisfied always and everywhere. In most cases structural axioms are existential in character, but if defined

notions are introduced in the formulation of axioms, then it is possible for axioms to appear universal in character, but still to express structural conditions" (Suppes, 1980, p. 181).

(22) Arrow (1951, 1967); Fishburn (1973); Kelly (1978); Luce and Raiffa (1957, pp. 327-370); Sen (1977, 1986).

(23) von Neumann and Morgenstern (1947); Luce and Raiffa (1957); Shubik (1983).

(24) On the relation between these theories and decision theory see Arrow (1957).

(25) Several kinds of decision theory are not mentioned in this brief overview, because, notwithstanding all their distinguishing characteristics and unique features, the character of their rationality concept remains the same: instrumental, formal and analytic (RVR as discussed in section 1.5). These include Jeffrey's theory where there is but one set of propositions, Jeffrey (1965, 1982); Causal decision theory -- Gibbard and Harper (1978), Skyrms (1982); and conditional expected utility theory -- Luce and Krantz (1971).

(26) See, for example, Harsanyi (1977a). Sen (1985) and Black (1985) criticize the consistency requirement as insufficient for rationality.

(27) "[M]y rationalism is not self-contained but rests on <u>irrational</u> faith in the attitude of reasonableness. I do not see that we can go beyond this" (Popper, 1963, p. 357; italics added).

(28) "A rationalist ... is a man who would rather be unsuccessful in convincing another by argument than successful in crushing him by force ... [W]hat I call ... the rationalistic attitude ... is an attitude which tries as far as possible to transfer to the field of opinions in general the two rules of every legal proceedings: first, that one should always hear both sides, and secondly, that one does not make a good judge if one is a party to the case" (Popper, 1963, p. 356).

Indeed Popper's attack on Utopianism and the restriction of rationality to the rationality of argumentation and communication can be seen as a result of (i) his identification of the rationality of action with RVR (p. 358); (ii) his perception that it is impossible to determine ultimate ends (which are required by RVR) by purely scientific means (p. 359), and; (iii) his belief that because of (ii), Utopian ultimate ends can be determined only by force (p. 360). But if RVR is to be rejected (as is argued in this dissertation) and if an alternative R-concept is presented, then perhaps a way may be found to make comprehensive plans without falling into the trap of Utopianism while entertaining an R-concept which is wider than that of argumentation and communication alone.

(29) "It would be possible to define rational behavior as behavior that stems from a rational state of mind, i.e., action according to rational plans and rational beliefs" (Elster, 1982, p. 1'2).

(30) On these two interpretations of theories of rational action, viz., the descriptive and normative, and tests of decision theories under these interpretations see e.g., Davidson et. al. (1955); Tversky (1975).

(31) According to Hooker (1975b, 1977) five levels can be distinguished within the scientific practice: (1) Applied theory: "including theory for instrumentation, where detailed models are constructed for specific situations;" (2) General theory: "wherein the general principles of a theory, not situation-specific, as systematized and developed;" (3) Proto theory: "at which those background theories too fundamental to normally be questioned are explicitly developed;" (4) Abstract theoretical framework: "at which abstract mathematical or logical structures are delineated" (e.g., Hilbert space theory, theory of relations); (5) Systematic ontology: "wherein the fundamental forms assumed for the world are made explicit" (e.g., atomic, plenum or process systematic ontologies) (Hooker, 1977, p. 13).

(32) Hooker (1975a) emphasizes that a theory of the nature of rationality is an indispensable ingredient of any meta-philosophy for a philosophy of science.

Chapter 2: The Ideal Received View Rationality (RVR) is not Universally Applicable

> "If we start from a well-founded ... thought which another has bequeathed to us, we may have hope by continued reflection to advance further than the acute man to whom we owe the first spark of light." (I. Kant, Prolegomena 260)

> "[The] philosophical and distributive implications of the paradox of social choice are still not clear. Certainly, there is no simple way out. I hope that others will take this paradox as a challenge rather than as a discouraging barrier." (K. J. Arrow, Nobel Prize Lecture, 1972)

2.0 Overview

Defense 1 of the claim that RVR (the Received View Rationality) is adequate for policy theories is rejected in this chapter. According to Defense 1 ideal RVR is adequate for policy theories because it is context-free rationality (CFR) and hence universally applicable. That CFR is not possible, and hence not universally applicable, follows from an Arrovian Meta-Theoretic Impossibility Theorem (AMTIT). AMTIT claims that there is not any context-free choice theory adequate for the, so-called, finite generalized choice structure. The rejection of CFR paves the way for the main work of this thesis, namely the criticism of RVR in general and the construction of an alternative concept of rationality on the basis of the examination of actual cases.

Section 2.1 introduces some terminology used in the discussion. In particular, the finite generalized choice structure is a finite multi-dimensional choice structure. The bulk of the chapter establishes and defends AMTIT. The property of choice theories of being context-free and adequate for the generalized choice structure is characterized in 2.2 by eight necessary conditions, CF1-CF8. No claim for the sufficiency of CF1-CF8 is made. AMTIT is established in 2.3. First Fishburn's (1976) notion of the representability of a choice function by a preference relation and his theorem (1976) concerning the representability of a choice function by a weak order are introduced. Arrow's celebrated Impossibility Theorem (1951; 1963) is presented. Then AMTIT is established by deriving the conditions of Arrow's theorem from CF1-CF8 with the help of Fishburn's theorem mentioned above. This derivation is done by interpreting CF1-CF8 in the domain of welfare economics for which Arrow's Impossibility Theorem was originally proved. AMTIT is defended against various criticisms claiming that it is a mere repetition of Arrow's theorem and thus vulnerable to the controversy that has accompanied Arrow's theorem since its publication. This is done in 2.4 where, in addition, the power of AMTIT is exemplified with respect to an open problem in the theory of rationality. A methodological disparity between AMTIT and Arrow's theorem is stressed. AMTIT as a meta-theoretic theorem can only be vulnerable to criticism that it is not sound, i.e., that CF1-CF8 are not justified (as expressing requirements from any context-free choice theory adequate for the finite generalized choice structure) or that the derivation of AMTIT from CF1-CF8 is not valid. But the controversies concerning the descriptive or normative adequacy of Arrow's conditions in the domain of welfare economics, or in any other branch of science, are simply irrelevant for AMTIT. Finally, the argument that some RVR instances which are members of some class are not universally applicable and that, therefore, Defense 1 has to be rejected, is presented in detail in 2.5.

2.1 Terminology for Choice

A fruitful discussion of the possibility of context-free choice requires an ordered framework to proceed. For this purpose some of the standard terminology used to discuss choice theories and choice functions, e.g., by Arrow (1959), Fishburn (1976), Sen (1971), or Suzumura (1976), is introduced. In addition, some terms which are used later in this chapter, as the adequacy of a choice theory to some choice structure are defined.

2.1.1 Choice: Using the framework of set theory it can be said that a choice is made when a subset is selected from a given set. Assume that there is a set X, to be interpreted as a basic set of alternatives. It may happen that only some subset S of X is available for choice. A subset of S which is chosen from it is called the choice set from S.

2.1.2 Choice Function: Let X be a set, K a family of non-empty subsets of X. A function, C, which for every S in K determines a non-empty subset C(S) of S, is called a choice function defined over K. C(S) is called the choice set (from S according to C). A choice function that has a non-empty C(S) for every non-empty finite $S \subseteq X$ is called a finitely complete choice function.

2.1.3 **Choice and Preference:** The notions of choice and preference are interwined. As Sen (1982a, p. 1) remarks, preference is prior from first person viewpoint, but from an outside observer's viewpoint choice is observed and only then preferences are surmised. Accordingly, theories of choice deal also with preferences and theories of preferences deal with choices. In particular, requirements of rationality, being related to "the mental machinery" (Suppes, 1980, p. 182) are usually expressed in terms of preferences. They apply also to choices via the connections between preferences and choice. But requirements of rationality can be expressed directly in terms of choice. Some of the requirements of being a context-free, presented below in terms of choices (e.g., 2.2.2) serve also as requirements of rationality.

2.1.4 **Preference as a Binary Relation:** Preference is supposed to be a binary relation. Let R be a preference relation: xRy means that x is at least as preferred as y (or that x is not less preferred than y). Strict preference, xPy, (i.e., that x is strictly more preferred than y) is defined as xRy and not yRx. Indifference of preference, xIy, (i.e., that x and y are indifferent in terms of preferences) is defined as xRy and yRx. As any binary relation, R (the preference relation) may or may not have such properties as reflexivity, symmetry, asymmetry, transitivity, completeness etc. The particular combination of such properties that R happens to have determines the type of choices made according to R.

In particular, the following properties are important for the discussion below:

Transitivity -- R is transitive on X if and only if for all x, y and z in X, if xRy and yRz then xRz.

Quasi-transitivity -- R is quasi-transitive on X if and only if for all x, y and z in X, if xPy and yPz then xPz.

Acyclicity -- R is acyclic on X if and only if there is no cycle of strict preference: that is, no subset $(x_1,x_2,\ldots,x_k)$ of X such that $x_1Px_2,x_2Px_3,\ldots,X_{k-1}Px_k$ and X_kPx_1.

Quasi-transitivity demands the transitivity of strict preference but not necessarily of indifference. Transitivity implies quasi-transitivity, but not vice versa and quasi-transitivity implies acyclicity but not vice versa.

2.1.5 Preferences as Order Relations: Of special interest are these preferences which are order relations. Order relations impose regularity of some sort on choices made in accordance with them. Some order relations can be interpreted as rationality requirements. The following order relations are mentioned in the discussion below.

Weak-order (Orderings): A relation R is a weak-order (an ordering) of X if and only if it is transitive and connected in X.

Strict partial order: A relation R is a strict partial order of X if and only if R is asymmetric and transitive in X.

2.1.6 R-maximal elements: The elements of a subset S or X which stand in the relation R to all the elements of S are the R-maximal elements of R is S;

$M(S,R) = \{x : x \in S \ \& \ xRy \text{ for all } y \in S\}$.

2.1.7 Representability of a Choice Function by a Relation: A choice function C can be said to be represented by a preference relation R if the choice according to R does not lead to results which are different from a choice according to C. A choice from some S according to R, i.e., a choice of the most preferred elements in S according to R, is the choice of the set of R-maximal elements in S. This choice does not lead to different results than a choice according to C when $M(S,R) \subseteq C(S)$.

2.1.8 Choice Functions and Generated Preferences: If C is a choice function on some K, then there are some binary preference relations which are generated by it. The intuitive idea is that the elements which are in the choice set of some subset S are preferred to (other) elements of S.

(i) xRy if and only if, for some S in K, $x \in C(S)$ and $y \in S$. R is interpreted as "at least as good as".

(ii; xR_by if and only if, $x \in C(\{x,y\})$. R_b is called the "base relation".

(iii) xP_ry if and only if, there is some S in K such that $x \in C(S)$ and $y \in (S-C(S))$. P_r is called the "(strict) revealed preference".

2.1.9 Preference Relations and Derived Choice Functions: When an R on X is given, the choice function C can be derived from it by noting, for every S in some K, those choice sets C(S) which satisfy the condition $C(S) = \{x \in S: xRy, \text{ for every } y \in S\}$.

2.1.10 Binariness (Normality) of the Choice Function: A choice function C is called a binary (or a normal, or a rationalized) choice function if and only if, for every S in K, the choice set according to the choice function which is derived from that preference relation generated by C is identical with C(S). The importance of the binariness of the choice function becomes clear in the discussion of context-free choice theories below.

2.1.11 Choice Structures: An ordered triple $\langle X,K,C \rangle$, where X is a non-empty set, K a family of non-empty subsets of X, and C a choice function on K is called a basic choice structure. An ordered n+3-tuple $\langle X,K,C_1,\ldots,C_n,C \rangle$ where X is a non-empty set, K a family of non-empty subsets of X, $C_1,\ldots,C_n$, n choice functions on K, n a positive finite integer, C a choice function on K such that C is determined by $C_1,\ldots,C_n$, is called a generalized choice structure. Each i $1 \leq i \leq n$ is called a dimension and C_i is called a dimensional choice function, C is called the overall choice function. Each of these structures can be classified into substructures according to structural conditions (or axioms) which may be required from X. When X is a finite set we can speak of the finite basic and finite generalized choice structure. In the sequel our interest will be only with finite structures.[1]

2.1.12 **Rationality and Choice**: A decision rule, or a maxim, or a principle of rationality, directs choice so that C(S) is chosen from S "according to reason" or in a rational way. Not all possible choice functions are rational. Thus, a concept of rationality constrains choice functions. The precise, formal, expression of an R-concept (a concept of rationality) is by conditions (or axioms) which should be satisfied by choice functions.

2.1.13 **Theories of Choice**: A theory of choice is a collection of conditions on choice structures. Some theories constrain X and K and some do not, but any choice theory constrains choice functions. This can be done in terms of conditions on C or on R, or both. For each choice theory there is a class (possibly the empty class) of choice functions which satisfy it. A choice function constrained by a choice theory can be seen as a maxim of choice. If at least some of the conditions which constrain a choice function express requirements of rationality, the theory is regarded as a theory of rational choice, and the maxim of choice which is implied by it (or the class of choice functions compatible with it) is a maxim of rational choice or of rationality.

2.1.14 Adequacy Requirement: A technical (formal) adequacy requirement for any choice theory, CT, is that the existence of a choice set, at least for some family of subsets, is derivable from CT. If this condition is not satisfied then CT is technically unreliable; it is not guaranteed that it leads to a choice. CT is a collection of conditions on choice structures (2.1.13). Therefore, a given choice theory may be adequate for a certain choice structure but not to others. In particular, some theories may be adequate for the basic choice structure, e.g., those which speak of only one choice function or a single preference relation, and some for the generalized choice structure, e.g., those that speak about a choice function C which is determined by n dimensional choice function $C_i, i=1,\ldots,n$.

Descriptive adequacy concerns the match or mismatch between CT and the actual way (or behavior) by which choices are made.

Normative adequacy of a choice theory concerns the justifiability of its conditions or its related maxim of choice when required from any rational agent, or the justifiability of the choices made by applying it on the basis of one or more of cognitive, prudential or ethical grounds.

The thrust of the argument of this chapter concerns the technical adequacy of some choice theories with respect to the finite generalized choice structure.

2.2 Necessary Conditions for Context-Free Choice Theory

The property of choice theories of being context-free and adequate for the generalized choice structure is characterized in this section by a list of eight necessary conditions, CF1-CF8, on choice structures. The motivation and the inspiration for CF1-CF8 are the conditions of Arrow's impossibility theorem (2.3.2). Yet, each condition is preceded by an argument which justifies its acceptance as a condition of this sort. It is on the basis of these arguments that the acceptability of CF1-CF8 as necessary conditions for being context-free choice theory adequate for the finite generalized choice structure is to be determined. These conditions serve in 2.3 below to establish a meta-theoretic impossibility theorem (AMTIT). AMTIT claims that a choice theory satisfying CF1-CF8 is impossible. AMTIT is used as a step in the argument that there is not any context-free R-concept and that, therefore, RVR is not universally applicable. Because of the negative nature of these results the restriction of the discussion to finite X (to finite choice structures) does not harm the argument.

2.2.1 **Unconstrained Basic Set of Alternatives**: To be context-free a choice theory must not impose any constraints (or structural conditions) on the basic set of alternatives, X. A theory which does contain some such constraints can only be applicable to those structures in which X satisfies those constraints. Such a theory fails to be context-free in the sense that there may be contexts for which it is not applicable. Nevertheless, the restriction of X to finite sets does not limit the force of the argument. For in order to show that it is impossible to have a context-free choice theory (for the generalized choice structure) it is sufficient to show that such a theory is impossible for a finite X. Besides, in any real-life choice situation the number of alternatives is finite. Thus the first condition for any context-free choice theory is:

Condition CF1: No constraints (structural conditions) on X, the basic set of alternatives, are allowed.

2.2.2 Partial Congruence of the (Overall) Choice Function C: Speaking in the terms of choice theories as specified above in 2.1, a context of choice is expressed by the given subset of alternatives, S, which is a member of K, the set of non-empty subsets of X, the set of basic alternatives. When T substitutes S, then the context of choice is changed and T is the new context of choice.

A strong requirement of context-sensitivity is the following: Given a family of subsets of alternatives $L \subseteq K$, and no matter how small or how large is L, the choice set from L, C(L), which is defined as the set whose members belong to the choice set of every set from L to which they belong, is empty. When this requirement is satisfied, the choice set of any subset which belongs to L cannot be determined directly by reference to C(L) but has to be determined according to the particular context which obtains.

For example assume that:

$L^1 = \{ \{x,y\}, \{x,y,z\}, \{x,y,z,w\} \}$

A choice function C_s selects the following choice sets: $\{x\}$ from $\{x,y\}$, $\{x\}$ from $\{x,y,z\}$ and $\{y\}$ from $\{x,y,z,w\}$. The set of winners in this example is empty.

In contrast a weak requirement of being context-free is just the opposite of that strong requirement of context-sensitivity, namely, that the set of winners in any family of subsets of alternatives L, is not empty. This requirement can be put more formally: Let $L \subseteq K$ be any non-empty subset of the set K of non-empty subsets of the set of basic alternatives, X. C(L) is defined by the condition that $x \in C(L)$ if and only if x is in $U_L S$ and x is in the choice set of every $S \in L$ in which it appears.

That is: $C(L) = \{x \in U_L S : x \in C(S) \text{ for all } S \in L \text{ for which } x \in S\}$

The demand that C(L) is not-empty for every finite and non-empty $L \subseteq K$ is Fishburn's (1976) Partial Congruence Axiom.[2]

When the Partial Congruence Axiom is satisfied a choice function like C_s is precluded. On the other hand, it should be admitted, sometimes choice functions like C_s are justified. This may happen when the perception of the choice problem and with it the basis for preferences among the alternatives, changes with the addition or subtraction of the alternatives. A change in the perception of the problem may involve at least one of the following: (i) Strategic considerations -- like opting for a second-best when a new threat appears in order to avoid an even worse outcome; (ii) Dynamic considerations -- sacrificing a short-term preference for a long term interest when a new opportunity appears, or <u>vice versa</u>; (iii) Modified expectations -- affecting and being affected by expectations of other agents, which may be related to the availability of some alternatives. In some situations no reasonable choice can be made without similar considerations. But choice functions like C_s cannot be justified on the basis of a context-free choice theory. A context-free choice theory cannot discriminate among possible interpretations.[3] It does not contain rules or injunctions which pertain to some specific interpretations and not to others. That functions like C_S are sometimes justified is true, but they are justified on the basis of the particularities of the situation. This requires an informational format which is much wider than that of the theory of choice functions as sketched above (2.1).

With this the second necessary condition for being a context-free choice theory can now be stated:

Condition CF2: The choice function, C, satisfies the Partial Congruence Axiom.

2.2.3 Genuine Multi-Dimensionality: Most choices and, clearly, most interesting choices are multi-dimensional. This means that the alternatives from which the choice is to be made, are evaluated and judged along several dimensions or attributes. These may refer to various measures of performance or potentials for satisfactions due to the choice of an alternative. For example: maximum speed, color, fuel consumption, number of passengers, costs and prestige value may be used for the choice of a new car. Another set of dimensions may be the virtuosity of the soloist performer, the conductor, the orchestra, the convenience and comfort of driving, parking, and seating inside the auditorium, and the social status of being present on the occasion. This set may be used to choose between two competing concerts on the same evening. To be context-free a choice theory must be applicable to situations like these. It has to enable making a rational choice when confronted with multi-dimensional choice situations. Now to be genuinely multi-dimensional the overall choice function C which is used to make the choice, has to be determined by some set of choice functions, C_i, $1 \leq i \leq n$, each corresponding to a dimension of choice. For if the choice is made by some function C which is not determined by the various dimensions, the choice is not multi-dimensional. To be genuinely context-free a choice theory cannot exclude those many cases where a choice has to be made on the basis of the dimensions (or attributes) of the alternatives. Thus a context-free choice theory cannot be restricted to those cases (if there are any) where even in what seems at first to be a multi-dimensional choice, the choice is made by a function, C, which is not determined by the C_i $1 \leq i \leq n$. The formal choice structure discussed above, for cases of choice from multi-dimensional alternatives is the generalized choice structure. In terms of this structure the third condition for being a context-free choice theory can be stated thus:

Condition CF3: In order to be applicable to the generalized choice structure, a choice function C, postulated by a choice theory, has to be determined by the C_i, $1 \leq i \leq n$, which correspond to the n dimensions of the alternatives.

2.2.4 Unanimity: When a choice has to be made in a multi-dimensional choice situation in which all the dimensional choice functions, C_i, $i=1,\ldots,n$ select the same subset $C_i(S)$ as the choice set when the given feasible subset of alternatives is S, then C, the overall choice function, must also select the same subset as its choice set, i.e., C(S) must be the same as $C_i(S)$. Any other choice by C can be justified only on the basis of some context-sensitive considerations. It seems rather absurd to allow C to choose any other subset of S as its choice set, and yet maintain that C is context-free. In particular, assume that there may be some pair of alternatives, x,y in X such that although according to all the dimensional choice functions $C_i, i=1,\ldots,n$, x is in the choice set from $\{x,y\}$ and y is not, yet x does not belong to the choice set from $\{x,y,\}$ according to the overall choice function C. It is absurd to allow such a pattern in a choice theory which is supposed to be context-free.[4] Therefore, the following condition prohibits this pattern of choice which is a clear example of context-sensitive choice.

Condition CF4: The pattern of choice where x belongs to $C_i(\{x,y\})$ and y does not, for all $i, i=1,\ldots,n$, and yet x does not belong to the choice set by the overall choice function C, cannot arise by a context-free choice function, for any pair of alternatives x,y, in X.

2.2.5 Partial Congruence of the C_i, $1 \leq i \leq n$: If all the C_i, $1 \leq i \leq n$ fail to satisfy the partial congruence axiom (2.2.2 above), and if all these C_i, $1 \leq i \leq n$ happen to choose the same subset of S as their respective choice set when faced with a set S of multi-dimensional alternatives, then C has also to choose this same subset as C(S) (because of Condition (CF4)). But then C itself does not satisfy this axiom, as against Condition (CF2). Then assume that some of the C_i satisfy this axiom and some do not. But this situation is impossible for a context-free choice theory. For those C_i's which do not satisfy the axiom can only be justified by the particularities of the situation. But then these C_i's, and with them the whole choice theory become context-dependent. Thus, the fifth condition for a context-free choice theory can be stated:

Condition CF5: All the dimensional choice functions, C_i, $1 \leq i \leq n$, have to satisfy the Partial Congruence Axiom, in order for the choice theory to be context-free.

2.2.6 Profile Generality: Without specific knowledge of the intricacies of a choice context there is no basis for discrimination -- either to require or to prohibit -- among profiles of preference relations among the alternatives. (Alternatively those profiles are profiles of choice among pairs of alternatives). Thus, a context-free choice theory has to allow all preference (or choice) profiles.

Condition CF6: All the profiles of choice (or preferences) among alternatives in X are allowed by any choice theory which is context-free.

2.2.7 Non-Degenerate Multi-Dimensionality: Assume that among the n dimensions there is a distinguished dimension, call it d, such that the dimensional choice function C_d determines by itself the choice sets by C, the overall choice function, from any subset of feasible alternatives $S \in K$, i.e., $C_d(S) = C(S)$ for any $S \in K$, without any regard to the n-1 remaining dimensional choice functions C_i. If such a case can arise then the multi-dimensionality of the choice situation is but an epiphenomenon; the situation is degenerated into a unidimensional choice situation. For a context-free choice theory such a case is objectionable twice over because it cannot discriminate among the various n dimensions. Each of the dimensions can in fact be that distinguished dimension d. By this the designation of any dimension as the privileged n dimension d is arbitrary. Thus, for a context-free choice theory such a case means an arbitrary reduction of the multi-dimensional choice structure to a unidimensional choice structure. Such a reduction is a distortion of the original intention to prepare for the construction of a context-free choice theory which is adequate for multi-dimensional choices.

In particular, assume that there is a dimension d such that, for all pairs x,y in X, if x belongs to C_d ({x,y}) but y does not, then x belongs to C ({x,y}) and y does not, regardless of the n-1 remaining dimensions. Such a pattern cannot be accommodated in a context-free choice theory which is adequate for the generalized choice structure. Therefore, the following condition prevents such a pattern.

Condition CF7: There is no dimension i such that for all profiles of dimensional choice functions and all pairs x,y in X, if x belongs to Ci ({x,y}) and y does not, then x belongs to C({x,y}) and y does not.

2.2.8 "Irrelevant Alternatives": Given some set of feasible alternatives, S, which is a subset of the set of basic alternatives, $S \subseteq X$, there are two possibilities for the construction of the choice function C. It can be constructed such that its domain is S and S alone, or its domain may include elements outside of S although its range is the subsets of S. In the first case C is said to consider only "relevant" alternatives; in the second case "irrelevant" alternatives are also included. The distinction between relevant and irrelevant alternatives can be introduced also in terms of the corresponding binary preference relation. Thus, in the first case preference relations are defined only over the alternatives in S; in the second case the field of these relations includes also elements which are not in S. That S should be included in the domain of C in any rational choice theory is trivial. But the inclusion of elements external to S in the domain of C is problematic.

There are at least three major problems involved in the notion of irrelevant alternatives for any context-free choice theory. First, by the inclusion of irrelevant alternatives the basic set of alternatives becomes indefinite. For when a context-free choice theory is the only ground upon which the recognition of the irrelevant alternatives should be made, there is not any basis for discrimination between what is not included in S. This means that, when the context-free choice theory is the only ground for determination of what counts as an irrelevant alternative, everything which is external to S have the same justification for being considered among the irrelevant alternatives for any S. In other words, the set of irrelevant alternatives is indefinite, for a context-free choice theory. But by this the very basic set of alternatives, X, is undermined. For everything may now be regarded as a member of X because it can be regarded among the irrelevant alternatives for any $S \subseteq X$ (Fishburn, 1974, p. 448). Only on the basis of contextual factors -- like knowledge of the choice situation and i*s intricacies, or at least the ability to utilize cues from the situation which surface as the process of controlling the situation unfolds -- can the determination of the irrelevant alternatives for some S be justified. Thus, we think it is true that Ms. Donna Rice is not among the set of irrelevant alternatives even if Mr. Garry Hart resigns (again) his candidacy. But it is only because we have some knowledge of the situation, and not because there is something in the theory itself which directs us to this recognition.

The second difficulty for the notion of irrelevant alternatives, when the choice theory is supposed to be context-free, is that the meaning of the preference relations over the alternatives, when irrelevant alternatives are included is doubtful, both foundationally and behaviorally (Fishburn, 1974, p. 448). This is so because the basic set of alternatives, X, becomes arbitrary and indefinite when irrelevant alternatives are allowed.

The third difficulty for the notion of irrelevant alternatives combined with context-free choice theory is that the very notion of choice requires stability of the set of alternatives, and of the preferences over the alternatives, at the moment of choice. The dependence of the choice on irrelevant alternatives prevents the desired stability because of the inherent indefinability of the set of irrelevant alternatives. The inclusion of some specific irrelevant alternatives in the domain of C, or put alternatively, in the field of the corresponding binary preference relation, can be saved from arbitrariness only by the use of contextual factors. But any choice theory which allows the use of contextual factors in order to establish the use of irrelevant alternatives, is not context-free.

By this the eighth condition for being a context-free choice theory can be stated:

Condition CF8: For any context-free choice theory, the domain of the choice function C includes only "relevant" (i.e., feasible) alternatives. Irrelevant alternatives are not allowed. In other words, for every $S \subseteq X$, C is sensitive only to the n C_i's over S. In particular, for any two n-tuples $[C_i]$ and $[C_i']$ of dimensional choice functions over any $S \subseteq X$ with C and C' the corresponding overall choice function, respectively, if for all i, for all $x,y \in S$, $x \in C(\{x,y\})$ if and only if $x \in C'(\{x,y\})$ then $C(S) = C'(S)$.

2.3 An Arrovian Meta-Theoretic Impossibility Theorem (AMTIT)

There is not any context-free choice theory adequate for the finite generalized choice structure. This is the claim made by the Arrovian Meta-Theoretic Impossibility Theorem (AMTIT). AMTIT is established in this section by deriving the conditions of Arrow's

Impossibility Theorem (Arrow, 1963) from the necessary conditions for being a context-free choice theory adequate for the finite generalized choice structure, CF1-CF8, discussed above (2.2.1-2.2.8). A theorem by Fishburn (1976, p. 1037) has a significant role in the derivation of Arrow's conditions from CF1-CF8. One of Arrow's conditions (C3 in 2.3.2 below) postulates that R, the social preference relation, and the R_i's, the individual preference relations of the members of the society, are all weak-orders. This condition has attracted most of the criticisms directed at Arrow's theorem and its applicability. None of CF1-CF8 requires explicitly that C and the C_i's should be representable by orderings. But it follows from CF2 and CF5 by that theorem of Fishburn about the representability of a choice function by a weak-order that if C and the C_i's satisfy the Partial Congruence Axiom (2.2.2 and 2.3.1) then C and the Ci's are thus respresentable. The rest of Arrow's conditions follow from CF1-CF8 by being interpreted in the domain of welfare economics. This is done in 2.3.3.

2.3.1 Representability of Choice Functions by Order Relations: There are two approaches to the construction of choice theories. The first proceeds by postulating some order relations over the alternatives-- which can be interpreted as preference relations -- and then by searching for properties of these relations which guarantee the existence of a non-trivial choice set of the set of those alternatives. The second proceeds in the opposite direction. It postulates the existence of a choice function (which leads to the selection of a suitable non-trivial choice set) and then to search for conditions which support the interpretation of this choice function.

Most of the work in decision theory is done in the first approach (Fishburn, 1970, 1981). This "bottom-up" approach is called here "the way up". The second, "top-down" approach is called here "the way down". It is exemplified by the theory of the demand function (Arrow, 1951, p. 16) or some theories for choice under uncertainty (e.g., Spohn, 1977).

The availability of these two ways gives rise to questions concerning their relationship. Does the way of constructions influence the kind of results which can be achieved in either way? or, under which conditions it does not make a difference whether a choice theory is constructed by the way up or the way down? A pragmatic difference between choice theories can be said to exist in case the choice theories lead to different choice sets in the same circumstances. Two criteria can be suggested for the sameness or difference of choice sets; the first is identity and the second is inclusion. For the purpose of the discussion in this chapter the criterion of inclusion is used. It will be said that there is no pragmatic difference between two choice theories if the choice set according to one of them is contained within the choice set according to the other. Thus, conditions are looked for, under which in the same circumstances, the choice set according to a choice theory built in one of those two ways (the way up or the way down) is contained in the choice set of a choice theory built in the other way.

The question of the relationship between theories built in the way up and in the way down is discussed, e.g., in Arrow (1951, 1959); Sen (1971); Richter (1966). The discussion which follows is based on Fishburn's (1976) treatment under the heading of "Representable Choice Functions."

A distinction is made between the choice set, C(S), from a subset of alternatives, S, according to a choice function C, and the choice set, C(S,R), from a subset of alternatives, S, according to some order relation, R, where $C(S,R) = \{x \in S : yRx \text{ for no } y \in S\}$. In other words, C(S,R) is the set of alternatives in S which are R-maximal within S.

Representability of a choice function by a binary relation is defined by Fishburn (1976, p. 1034) as follows:

> "A choice function C from K into the non-empty subsets of X is <u>representable</u> by a binary relation of a specified type (e.g., by a strict partial order, or by a weak order) if and only if there is a binary relation R on X of the specified type such that C(S,R) is a non-empty subset of C(S) for every S in K."

The searched for condition for pragmatic indifference between ways of constructing choice theories can now be restated in terms of representability in the sense defined here. When the choice function, which is postulated by way down theories, is representable by a binary relation, postulated by way up theories and interpretable as a preference relation, then there is no pragmatic difference between the pair of choice theories.

(1) As stated in the definition given above, representability of a choice function by a binary relation, R, requires that the subset

of R-maximal elements in S is a non-empty subset of C(S). By this the acylicity of R, i.e., that "there is no n>1 and $x_1,\ldots,x_n$ in X such that $x_1Rx_2, x_2Rx_3, \ldots, X_{n-1}Rx_n$, and X_nRx_1" (Fishburn, 1976, p. 1033) is required. For otherwise, when R is allowed to be cyclic, then C(S,R) can be empty, even for a finite S, whereas if R is acyclic then C(S,R) can be empty only if S is an infinite set (Fishburn, 1976, p. 1034). Because we are interested in the case of finite S's, we can conclude that acyclicity of R is required for the representability of C in terms of R.

(2) Moreover, acyclicity of R is a minimal rationality requirement concerning preference patterns. Without it money-pumps[5] can be contrived against an individual whose preferences are cyclic.

(3) By a theorem of Fishburn (1976, Lemma 1, p. 1035), when C is a choice function from K into the non-empty subsets of X, acyclicity of P on X such that, for all S in K, there is a $y \in C(S)$ such that yPx for all $x \in (S-\{y\})$, i.e., when the asymmetric component of R is acyclic and it guarantees that in any subset $S \in K$ there is a member of the choice set of S which is maximal (or a "winner") according to P in S, then C is representable by a weak order, and vice versa. In other words, that there is an acyclic P on X such that for any given $S \in K$ the maximal member of P on S is included in C(S) is equivalent to the representability of C by a weak order.

(4) A necessary and sufficient condition for the representability of a choice function by a relation which is a weak order is given by

the following theorem (Fishburn, 1976, Theorem 2, p. 1037):

> "If C(S) is finite for every S in K, then the choice function C is representable by a weak order if and only if C satisfies the Partial Congruence Axiom."

The Partial Congruence Axiom is stated above (2.2.2). It appears there as a condition for being context-free. Its impact is brought by this theorem.

To recapitulate: Our interest here is with finite basic sets of alternatives. When X, the basic set of alternatives is finite, so is K, the set of non-empty subsets of X, and so are each of the subsets $S \in K$. Thus, all the $C(S) \subseteq S$ are finite too. Given this, when a binary relation P is asymmetric, then it only needs to be complete too in order to establish the equivalence between the representability of C by a weak-order and the acyclicity of P. For by P being complete it is secured that if P is acyclic then in every finite $S \in K$ there is a P-maximal element. But by this C is representable by a weak-order on X. On the other hand, this representability is equivalent to the satisfaction of the Partial Congruence Axiom. In addition, the pragmatic indifference between choice theories which are built either in the way up or on the way down is equivalent to the representability of C, which is postulated in the way-down theories, by a suitable relation R, postulated in the way-up theories. This representability was found to be equivalent to the acyclicity of a complete P and complimentarily to the satisfaction of the Partial Congruence Axiom.

In other words, by requiring (a) the satisfaction of Partial Congruence Axiom nothing more is required than (b) the existence of an acyclic P on X such that for any given S∈K the maximal member of P in S is included in C(S). This is so because both (a) and (b) are found equivalent to (c) the representability of C by a weak-order, when (d) C(S) is finite for every S in K. But (d) always holds for finite choice structures. Thus, for finite choice structures (a) (which is required by CF2 and CF5) leads to (b) (which is the minimal rationality requirement of acyclicity of P, together with the technical adequacy requirement of being a finitely complete choice function) and to (c). By this it is not necessary to postulate the existence of orderings over X. The Partial Congruence Axiom, which is justified as a necessary condition for being a context-free choice theory adequate for the finite choice structure is sufficient.

2.3.2 **Arrow's Impossibility Theorem**: Inventing or discovering a new theorem may sometimes require a considerable ingenuity, yet it may be a short duration event. Comprehending the import and importance of such a theorem may be a lengthy process. Many years may be consumed in the process of coming to grips with the new theorem. Arrow's theorem was proved within three weeks since Arrow became intrigued by the question: "In what sense could collectivities be said to have utility functions?"[6] (Sen, 1985a, p. 1766). Yet about forty years later, Sen (1985a, p. 1765) could say that "[a]s it happens the nature of the impossibility theorem is itself a subject on which some debate is possible."[7]

Arrow developed his theorem (1951, 1963) in the context of welfare economics.[8] In the tradition of neo-classical economic theory[9] welfare economics, though it is "concerned with the extent to which the objectives of the society as a whole are fulfilled rather than the private objectives of its members" (Winch, 1971, p. 13), takes the individuals and their preferences as basic. If individuals' preferences are basic, then social choice, which is the (economic) choice of a society as a whole should be grounded in individual preferences or values. If the so-called social welfare function which is supposed to be the societal equivalent of the individual preferences (or utility function),[10] is grounded in preferences of individuals, then it is to be constructed from these preferences (which according to the neo-classical approach in economics are the only existing autonomous preferences). A social welfare function has to be somehow aggregated from individual preferences.

Arrow's Impossibility Theorem[11] states that if the number of individuals in the society is finite and the number of alternative social states is at least three and if the preference relation between social states is a weak order (an ordering) then there is not any social welfare function, i.e., a function which for any n-tuples of ordering (over the social states) gives as its value an ordering, which satisfies some conditions expressing either rationality or democracy or non-triviality.

Let X be the set of alternative social states; $i=1,\ldots,n$- index numbers over the set of individuals; R_i -- the preference order of person i; R -- the binary relation of social preference; $\{R_i\}$ -- where for each person i there is an R_i -- a profile (of preferences); f -- a social welfare function which for every preference profile gives a social preference relation R ($R=f([R_i])$). Then the following theorem holds:[12]

Arrow's Impossibility Theorem: There exists no social welfare function f satisfying the following conditions C1, C2, C3, U,P,D, and I;

C1. n is a positive integer.

C2. The number of alternatives in X is finite and at least 3.

C3. R and each R_i are orderings (weak-orders).

"Condition U (Unrestricted Domain). The domain of f includes all logically possible n-tuples of individual preference orderings on X.

Condition P (Weak Pareto Principle). For any x, y in X, if everyone strictly prefers x to y, then xPy.

Condition D (Non-dictatorship). There is no person whose strict preferences over any pair <x,y> is invariably reflected in social strict preference, i.e., there is no i such that for all profiles in the domain of f and all pairs <x,y> in X, if xP_iy, then xPy.

Condition I (Inopendence of Irrelevant Alternatives). If for any subset S of X, everyone's preferences remains the same for every pair of alternatives from S, then the choice set of S should remain the same too, i.e.,

> xR_iy if and only if xR'_iy for all x,y in S, for all i, implies that C(S) = C'(S), when C(S) and C'(S) are the chosen elements of S under the two profiles [R_i] and [R_i'] respectively" (Sen, 1977, pp. 164-165).

2.3.3 Arrovian Meta-Theoretic Impossibility Theorem: Although Arrow proved his theorem in the framework of welfare economics, there is nothing to his theorem and its proof which is specific to welfare economics. Indeed it was recognized quite early by May (1954) that the theorem holds for any multi-attributed, or multi-dimensional choice theory.[13] A vast literature appeared since 1951 dealing with the theorem in particular and with the new subject of social choice theory that aroused out of the response to this theorem.[14] The interpretation of this theorem is still a debated subject. Usually it is seen as pertaining to welfare economics or social choice theory or political science or even as touching moral and political philosophy.[15] Many writers try to find safe avenues -- in their fields of interest -- which are not vulnerable by Arrow's theorem. Some of these are discussed briefly in the next subsection.

In this work Arrow's result is ascended to the meta-level of choice theory. The Arrovian Meta-Theoretic Impossibility Theorem (AMTIT for short), as it is called here, claims the impossibility of some sort of choice theories. By this it belongs also to the general theory of rationality, for, as will become clearer soon, an impossibility of this sort of choice theories reflects an impossibility inherent in the theory of rationality. AMTIT is capable of being interpreted in various domains. The original impossibility theorem can be arrived at from AMTIT by interpreting it in the domain of social choice.

AMTIT is derived from the eight necessary conditions for any context-free choice theory CF1-CF8 (2.2.1 through 2.2.8) and the representability theorem of Fishburn (1976) (2.3.1), by interpreting these conditions in the domain of welfare economics. The result of this interpretation is identical with the conditions of Arrow's Impossibility Theorem (2.3.2). Because these conditions are contradictory (as is revealed by the proof of Arrow's theorem) it follows, that these necessary conditions for any context-free choice theory, which implies them, are contradictory, as is claimed by AMTIT.

Six components can be distinguished in the derivation of the conditions of Arrow's Impossibility Theorem from the conditions CF1-CF8 of 2.2.18.

(a) Because of conditions CF2 and CF5 the overall choice function C and the dimensional choice functions, C_i $i=1,\ldots,n$, satisfy the Partial Congruence Axiom (2.2.2 and 2.2.5). As is proved by Fishburn (1976) in his representability theorem (2.3.1), when the choice set C(S) of every feasible subset of alternatives S is finite, then the choice function C is representable by a weak order if and only if C satisfies the Partial Congruence Axiom. Our interest is with the finite generalized choice structure, for which X is finite, and so are all the $S\in K$ and, thus, each C(S) for each $S\in K$. Therefore, the functions C and C_i, $i=1,\ldots,n$, which are mentioned in conditions CF1-CF8, are representable by weak orders. This means that, for each choice function C, C_i, i,=1,...,n, there are weak orders R, R_i, i=1,...,n, respectively, such that $C(S,R) \subseteq C(S)$ and $C_i(S,R_i) \subseteq C_i(S)$, for every feasible subset of alternatives S in K. In other words, there exist an R and i,=1,...,n, R_i's such that the R-maximal and the R_i-maximal elements in any subset $S \in K$ are included in the choice sets C(S) and $C_i(S)$, i=1,...,n, respectively, where R and the R_i's are weak-orders. Thus, the selection of the choice set C(S) via the choice function C can be substituted by the selection of the R-maximal elements in S which form a subset of C(S).

If the chosen elements from S are selected via R (i.e., C(S,R), the subset of R-maximal elements in S) then, in order to guarantee that the choice via R is context-free, some conditions have to be made with respect to R and the R_i corresponding to those with respect to C and C_i, i=1,...,n. Otherwise the R_i's and R may not lead to context-free choice. Thus, the conditions CF3, CF4, CF6, CF7 and CF8 have to be reformulated for R and R_i, i=1,...,n, where these are orderings.

(b) When condition CF3 is reformulated for the R_i's and R, and interpreted in the domain of welfare economics, the result is the definition of f, the social welfare function. I.e., $R=f([R_i])$, i=1,...,n, where all the R's are orderings, each of the R_i's is now an ordering of individual i of social states, instead of a dimensional choice function C_i, R is the social ordering of social states instead of C, the overall choice function, and f is the function by which R is determined by the R_i instead of the determination of C by the n C_i's.

(c) Similarly, when the following conditions are reformulated for R and the R_i's and interpreted in the domain of welfare economic, the following conditions of Arrow's theorem follow from the conditions for being context-free: U results from CF6 (and reinforced by CF1), P results from CF4, D results from CF7 and I results from CF8). The details of these derivations are as follows:

Condition U states a requirement of profile-generality in terms of the R_i's. Condition CF6 states a requirement of profile-generality in terms of the C_i's. Thus, U results immediately from CF6 by the above mentioned transformations. Condition CF1 is added because if there are constraints on X they lead to constraints on the R_i's (to recall $R \subseteq X \times X$). Moreover, as will be discussed in the next subsection, one of the ways out of Arrow's theorem is by restrictions on the R_i's. Therefore condition CF1, which requires X to be constraint-free is added.

Condition P results immediately from CF4 when it is noted that xPy (i.e., x is strictly preferred to y) if and only if x belongs to the choice set from {x,y} but y does not. Similarly D results from CF7. I results immediately from CF8 by similar transformations as mentioned above with the addition that xR_iy is substituted by the base relation, R_b, generated by C (2.1.8). It is clear that R_b represents choices by C over pairs from X.

(d) Condition C1 of Arrow's theorem, i.e., the claim that $n>1$, the number of individuals, is a positive integer results from the definition of the finite generalized choice structure. To recall this is a finite multi-dimensional structure. The same holds for that part of C2 which allows only a finite number of alternatives. The finite generalized choice structure allows only a finite number of alternatives and a finite number of dimensions along which they are judged.

(e) The requirement that there are at least three alternatives, C2 of Arrow's theorem, is a constraint required by the proof of the theorem. If there is not any choice theory of the required sort for the case where there are at least three alternatives, then there is not a context-free choice theory of the required sort in general. Therefore, this constraint does not harm the generality of AMTIT.

(f) That the preference relation dealt with is an ordering, C3 of Arrow's theorem, follows from CF2, CF5 and Fishburn's (1976) representability theorem, as discussed earlier ((a)).

Thus, all the conditions of Arrow's Impossibility Theorem result when the necessary conditions for any context-free choice theory adequate for the finite generalized choice structure are interpreted in the domain of welfare economics while Fishburn's (1976) representability theorem is taken into account. By this the following theorem has been established:[16]

<u>Arrovian Meta-Theoretic Impossibility Theorem</u> (AMTIT): <u>A context-free choice theory adequate for the finite generalized choice structure</u>--

i.e., a choice theory satisfying conditions CF1 through CF8 of 2.2.1-2.2.8 above -- is impossible.

2.4 Criticisms, Rebuttals and Implications

AMTIT is put to a test by a maximal objection. In a nutshell it says (2.4.1) that the controversiality of Arrow's result remains and nothing is added by the meta-theoretic twist. The components of the maximal objection are rejected one by one. First it is noted (2.4.2) that there is a methodological disparity between AMTIT and Arrow's Impossibility Theorem. Arrow's theorem can be criticized as not satisfying descriptive or normative adequacy criteria as a theorem of welfare economics. On the other hand, AMTIT speaks of choice theories in general. It can be criticized only on the basis of its soundness. This is a strategic response to the maximal objection. Although it is sufficient to reject it, each of the components of the maximal objection is dissected and rejected in 2.4.3. Sen's reviews of social choice theory (1977, 1986) are used in examining the alleged controversiality of Arrow's result and the potential escape routes from it. It is illustrated by reference to Sen's reviews, that various seemingly escape routes either fail or are context-sensitive. The power of AMTIT is illustrated in 2.4.3.6 by its ability to settle conclusively (in the negative) a problem left open by Suppes (1960, 1980).

2.4.1 A Comprehensive Objection: Apart from claims of non sequitur a maximal objection against the preceding discussion seems to be the following:

"The conditions CF1-CF8 are nothing but Arrow's conditions in disguise. These conditions are questionable in the field where they have been introduced. The attempt made here to ascend them to a new status in the theory of rationality does not remove the air of controversiality from them. Many positive possibility theorems can be proved when some of Arrow's conditions are modified or substituted. To stipulate them as conditions for a general theory of choice or even to base the theory of rationality on controversial axioms like Arrow's conditions is therefore a defeated attempt. Moreover, even were it successful, it would have add nothing, it is only an awkward restatement of a known result."

In the sequel the claims of this comprehensive objection are rejected one by one, following a strategic response which points a methodological disparity between Arrow's theorem and AMTIT.

2.4.2 **A Methodological Disparity**: It is important to realize that the descriptive or normative adequacy of Arrow's conditions C1-C3, U,P,D, and I of his impossibility theorem (2.3.2) has nothing to do with the formal validity of his proof which shows that these conditions are contradictory. This rather elementary logical point marks the methodological dividing line between those kinds of criticisms which can be reasonably directed against Arrow's original impossibility theorem, on the one hand, and against AMTIT on the other.

As a theorem in welfare economics or in social choice theory, Arrow's impossibility theorem is criticizable for its empirical and normative adequacy. The criticism can be directed against a single condition, or some of them together, or against the theorem as a whole. Formal work intended to find sets of conditions which guarantee the possibility of an aggregation scheme for preferences, or social welfare functions, which, hopefully can be interpreted as empirically and normatively adequate is also called for. So are attempts to bypass the whole issue as based on fundamental but mistaken assumptions which are avoidable. Sen's (1977, 1986) surveys provide examples of responses to Arrow's theorem along these lines.

The criticism to which AMTIT is open are different. First, the conditions CF1-CF8 (2.2.1-2.2.8) can be criticized as making demands which are not necessary for any context-free choice theory adequate for the generalized choice structure. Second, the derivation of Arrow's conditions C1-C7 from conditions CF1-CF8 in 2.3.4 can be criticized for its validity. Third, by providing an example of a possibility theorem -- by way of some modification of Arrow's conditions or some variation on them -- all of whose conditions may be shown to be context-free. Questions of empirical and normative adequacy of Arrow's conditions _qua_ a theory of social choice or welfare economics are simply irrelevant for AMTIT.

The first kind of criticism is, hopefully, rebutted by the arguments which precede each of these conditions in 2.2.1 through 2.2.8. It is on the basis of the arguments and reasons which precede each of the conditions that its acceptability should be decided. If these arguments are sound then conditions CF1-CF8 should be regarded as necessary conditions for any context-free choice theory adequate for the generalized choice structure. If these arguments are convincing they substantiate the interpretation of Arrow's theorem as expressing within the framework of welfare economics a meta-theoretical insight.

The detailed derivation of Arrow's conditions from CF1-CF8 in 2.3.4 stands, hopefully, against criticisms of the second kind. If the stages of this derivation are valid, then Arrow's conditions result from CF1-CF8.

If these two kinds of criticism are rebutted, then the third kind does not have any chance. Nevertheless, because the methodological status of Arrow's theorem and the discussions which stemmed from it is not as clear as it should be, criticisms of the third kind are discussed below. These discussions and the methodological disparity addressed in this subsection provide the answer to the comprehensive objection made above.

2.4.3 **Rebuttals**: The component criticisms of the comprehensive objection (2.4.1) are examined and rejected one by one.

2.4.3.1 **"It is nothing but Arrow's condition in disguise"**: Indeed the motivation behind the formulation of CF1-CF8 is to make Arrow's conditions derivable from them. Yet the "nothing but" claim is radically mistaken. For the methodological status of Arrow's conditions and CF1-CF8 is different (2.4.2). Arrow's conditions are justified if they are descriptively and empirically adequate in the domain of welfare economics or social choice. CF1-CF8 are justified if indeed they are necessary conditions for any context-free choice theory adequate for the generalized choice structure.

2.4.3.2 "Arrow's conditions are questionable": Bearing in mind the methodological disparity discussed above (2.4.2), this claim is irrelevant for CF1-CF8 and AMTIT. Arrow's conditions may be questionable, descriptively and normatively, as conditions pertaining to welfare economics or social choice. Yet, it is clear that formally speaking they are contradictory. If a set of contradictory conditions follows from another set of conditions, then the conditions of the second set are contradictory too. If the conditions in the second set have their justifications which do not depend on the justification of the conditions in the first set, then the result that the second set of conditions is contradictory is of some interest. The issue of the questionability of Arrow's conditions does not play any role in the evaluation of AMTIT.

2.4.3.3 "Arrow's conditions remain controversial even when they are ascended to the meta-level": The same response given in 2.4.3.2 applies here as well. For the sake of the argument let it be assumed that each of Arrow's conditions is not only controversial but also wrong headed, inadequate descriptively and normatively in the domain of welfare economics or social choice. As long as it is recognized that Arrow's conditions are contradictory and as long as the arguments presented in 2.2.1-2.2.8 are regarded as justifying the acceptability of CF1-CF8 then the power of AMTIT does not depend on the adequacy or inadequacy of Arrow's conditions as axioms pertaining to welfare economics.

2.4.3.4 "Various positive possibility theorems can be proved when some of Arrow's conditions are modified. This shows that it is arbitrary to insist on Arrow's conditions." Indeed, some positive possibility theorems have been proved.[17] But all these positive possibility theorems relate to context-sensitive choices, either because of the use of context-sensitive means or by being dependent on context-sensitive justifications. Some of the better known examples of positive possibility theorems, and also of unsuccessful attempts to escape Arrow's theorem are discussed immediately in order to illustrate this claim.

(i) Weakening of the transitivity of R: C3 of Arrow's conditions (2.3.2 above) requires R and each of the R_i's to be weak-orders (in the set X). Weakening this requirement has been one of the main escape routes from Arrow's theorem. A minimal technical adequacy requirement for any choice theory is that it guarantees the existence of a non-empty choice set C(S), for any subset of alternatives, S, of a finite set of alternatives X. A necessary and sufficient condition for this property, called "finitely complete choice function" by Sen (1986, p. 1079) is that R is acyclic, reflexive and complete (Sen, 1986, p. 1079). A relational collective choice rule which always generates an R such that C(S,R) is non-empty for all non-empty

S is called a social decision function (SDF) (Sen, 1977, p. 166). It was proved that for a finite X there is an SDF satisfying conditions U,I,P and D. This result may raise the expectation that by confining social preference to an acyclic, reflexive and complete relation the spell of Arrow's theorem is dissolved. Were this the case, it would have strengthened the claim that Arrow's conditions are arbitrary (for social choice). But, as Sen (1986, p. 1087) remarks, "even acyclicity does not help much in delivering us from the Arrow problem."

Three responses can be made to the challenge of this alleged counter-example: (a) CF1-CF8 are necessary but not sufficient conditions for being context-free. Other conditions may be added. The positive responsiveness (Condition PR) is a condition of this sort. PR requires that for any x and y which belong to X, if for all i, $(xP_iy \rightarrow xP'_iy \ \& \ xI_iy \rightarrow xR'_iy)$, and for some i, $(xI_iy \ \& \ xP'_iy)$ or $(yP_ix \ \& \ xR'_iy)$, then $xRy \rightarrow xP'y$. What this condition says is in fact that "[s]ocial preference is required to move in the same direction as individual preference" (Sen, 1977, p. 167; 1986, p. 1085). It is proved that "[f]or any SDF satisfying Conditions U,I,P and PR, if there are at least four individuals, then someone has a veto." A vetoer can be justified, if at all, on the basis of context-sensitive considerations. That someone will have the right to veto is not a requirement of either democracy or rationality. There is no reason to demand it from any social choice context. Similarly it cannot be taken as a requirement from any context-free choice theory. In the abstract there cannot be any reason to assigning a veto right to any dimension. It can be justified if at all, on the basis of the particular context of choice. Yet PR is clearly, another condition of being context-free. Thus, the restriction of R, the overall (social) preference relation to acyclic (and reflexive and complete) relation cannot guarantee that it is possible to have a context-free aggregation scheme which can serve as a basis either for social choice theory for for context-free choice theory. When other conditions are added to the original U,P,I, and D, other impossibility theorem follow yielding either veto or dictatorship rights to one or the individuals (dimensions).[18]

(b) If R is required to be quasi-transitive (i.e., P is transitive but I is not necessarily transitive) then the following theorem has been proved: "Any SDF generating a quasi-transitive R and satisfying conditions U,I, and P must be oligarchic."[19] An oligarchy is "a unique group of persons in the community such that if anyone of them strictly prefers any x to any y (xP_iy), society must regard x to be at least as good as y (xRy), and if all members of the group strictly prefer x to y (xP_iy for all i), then society must strictly prefer x to y (xPy). Each person in the oligarchy has a veto" (Sen, 1977, p. 167). It is immediate that the existence of an oligarchy and its composition can only be justified by reference to some specific choice situation. In the abstract and especially so with regard to the generalized choice structure, there is not any reason why some of the dimensions should be given this privileged status of forming an oligarchy. Moreover, there is no reason why there should be an oligarchy at all. All these and of course the identity of the oligarchy (who is in it) can only be decided by context-sensitive considerations. It is interesting to note that as Sen himself shows (1970, pp. 52-3) the example by which he establishes the existence of an SDF satisfying conditions U,P,I and D uses a quasi-transitive relation.

(c) It is emphasized in 2.3.1 above that if C for a finite choice structure is finitely complete and there is an acyclic P such that its maximal member in any S in K is in C(S) then C is representable by an ordering. It has to be emphasized that if P lacks this property it cannot be relied upon to make choices according to it.

(ii) Another escape route from Arrow's theorem has been the attempt to work with functional collective choice rules. These specify not a social preference relation, R, for n-tuples of individual orderings, but a social choice function. As Sen shows (1977, pp. 178-183; 1986, pp. 1091-1103) all the impossibility theorems proved for relational collective choice rules can be translated into theorems about functional collective choice rules. Yet, there is one positive possibility theorem that should be evaluated. The "Choice-Functional Positive Possibility Theorem" (Sen, 1986, p. 1093) states that if the number of the individuals is at least 2 then there is a functional collective choice rule satisfying conditions which correspond to U,P,D and condition I, together with suitable conditions of anonymity (i.e., the value of the functional collective choice rule is invariant under permutations of the individual preference relations) and a condition of neutrality towards the social states and monotonicity of the social preference relation. Without studying in depth these additional conditions it can be verified that such a functional collective choice rule involves context-sensitive considerations. For Sen provides an example of such a function (p. 1094):

$C(\{x,y,z\}) = \{x,y,z\}$, $C(\{x,y\}) = \{x\}$,

$C(\{y,z\}) = \{y\}$, $C(\{z,x\}) = \{z\}$.

If nothing is known about the context, e.g., the nature of x,y and z, their availability, use and consequence, the purpose of the choice etc., then such a function which cannot be represented by one preference relation cannot be justified normatively. Why should it be required from any context-free choice function to be like this? Indeed for such a function the set of winners (i.e., those elements which are in the choice set of every subset which contain them) is empty, against the requirement of CF2 (2.2.2 above). Such a function can only be justified as a context-sensitive function. Therefore, this positive possibility theorem and other similar ones (Sen, 1986, p. 1101) are not counter-examples to AMTIT.

(iii) Sen (1986, 1977) distinguishes between two types of consistency requirements of choice, <u>contraction</u> consistency and <u>expansion</u> consistency. Consistency requirements demand some stability of choice when the choice situation undergoes some changes, either by being contracted or by being expanded. The sense of this stability is that some elements which are chosen before these changes must, under some conditions, be chosen after the changes. The standard contraction property is the so-called property α:

<u>Property α</u>: For all x, y in X and all S, T which are included in X; If x belongs to the choice-set from S and x belongs to T which is a subset of S then x belongs to the choice-set from T.

(For all $x,y \in X$, and all $S,T \subseteq X$, $[x \in C(S)$ & $x \in T \subseteq S] \rightarrow x \in C(T)$).

The standard expansion property is the so-called property γ:

<u>Property γ</u>: For all x,y in X, and all S,T subsets of X; If x belongs to the choice set $C(S_j)$ for all Sj in any class of subsets of X then x belongs to the choice set of the union of this class of subsets, $C(U_j S_j)$.

Sen is able to summarize his discussion of the consistency requirements (1977, p. 178; 1986 p. 1102) by saying that contraction consistency "raises rather serious problems, even when used on its own without any expansion consistency requirement, whereas the latter seems typically satisfiable unless coupled with some contraction consistency .... Property

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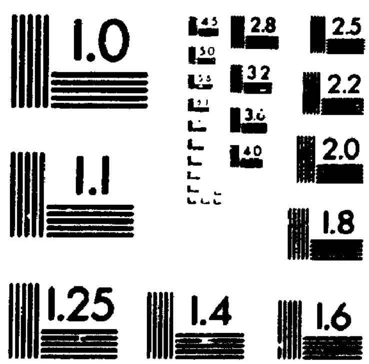


α, however, has a wrecking impact, and so has even Weak α" (1986, p. 1102). Indeed, some positive possibility theorems for functional collective choice rules are proved for cases where no contraction consistency requirement hold (Sen, 1986, pp. 1101, 1105).

The crucial point of our discussion is the relation between context-sensitivity or context-insensitivity and these consistency requirements. It can easily be seen that both properties α and γ are necessary for context-free choice functions. To insist that x does not belong to C(S) when $S \subseteq T$ and x belongs to S and to C(T) can be justified, if at all, only by an appeal to the particular context. Sen brings the following example to illustrate property α: "Sartre is the best living philosopher in the world, but is he the best living philosopher in France?" (1977, p. 181). But if the determination of someone as the best living philosopher in France is to be done by considerations which are different from those used to determine the best living philosopher in the world, because, say, they appeal to traditional schools of thought in France, to the various uses which can be made within France of such a determination because Sartre may be seen as a cosmopolite figure and somebody else, say Quasimodo, as better representing the French way of doing philosophy, then such a splitted choice can be justified. Yet, it is clearly a context-sensitive choice. The requirement of property α is, thus, concerned with being (internally) context-free. It prevents splitting the choice function to context-restricted subfunctions. Similarly with property γ. If x belongs to the choice set of every subset of alternatives in some class of such subsets, then, in the abstract, there are no reasons why x should not belong to the choice set from the union of the subsets within this class. Good reasons for this pattern require some appeal to the particularities of the context.

It is not surprising to see that both properties α and γ are implied by PCA (2.2.2). It is quite clear that if α does not hold then maybe there is not any set of "winners." Assume that $T = \{x,y,z\}$, $S = \{x,y\}$, $C(T) = \{x\}$ and $C(S) = \{y\}$. In this case x which belongs to S and T and to C(T) does not belong to C(S), though $S \subseteq T$. So that α is not satisfied. But then also PCA does not hold, for there is not any element which is in the choice set of every subset to which it belongs. By this it was shown that not property α implies not PCA. Thus, PCA implies α. That property γ follows from PCA is immediate. Simply take L in PCA to be $U_j S_j$ in γ.

Sen showed (1986, p. 1098) that the joint satisfaction of α and γ is equivalent to the binariness of the choice function. The binariness (or "normality" or "rationalizability" as it is called in the literature) of a choice function C means that the revealed preference relation which is generated by it (2.1.10) is adequate to generate back the choice function C itself. As PCA implies both α and γ it implies the binariness of any C which satisfies it. In other words, the binariness of C is required from any context-free choice function adequate for the generalized choice structure.

To conclude this discussion it can be said that the fact that some positive possibility theorems can be proved for some cases where no contraction consistency requirement hold is not a counter-example for AMTIT. For such theorems can only be proved for cases which are clearly non-context-free, because property α does not hold for them. Context-free choice requires the binariness or normality of the choice function. In Sen's (1977, p. 178) words:

> "There is obviously, nothing to be gained in terms of avoiding impossibility by moving from relational to functional collective choice rules if normality of social choice is to be insisted on."

(iv) We turn now to another escape route from Arrow's impossibility theorem, which takes issue not with the Collective Rationality requirement but with Condition U (Unrestricted Domain). The response to attempts of this sort are, simply, that even if successful and adequate for welfare economics or social choice, it is quite clear that any restriction on the set X or on the structure of preference relations over X cannot be justified but by an appeal to the particular context. Arrow's own example of single-peaked preferences (i.e., the case where all the alternatives can be so ordered so that the preferences of each of the individuals involved over them have just a single (local and global peak) is of that nature as are Sen's examples (1966, pp. 111-149).

(v) Attempts to escape from Arrow's impossibility by rejecting Condition I (Independence of Irrelevant Alternatives) are many.[20] Yet, even if its appropriateness for welfare economics or social choice can be questioned it seems to be inevitable for any context-free choice theory. For clearly, the dependence on irrelevant alternatives can receive a solid grounding by fixing some context of irrelevant alternatives from the, in principle, unspecified alternatives of this sort. The arguments in 2.2.8 should, hopefully, suffice to convey this point.[21]

When irrelevant alternatives are allowed interpersonal comparisons in terms of preferences are possible (Luce and Raiffa, 1956, p. 341). Such comparisons may lead to positive possibility theorems; "interpersonal comparability of the 'ordinal' sort, even without cardinality does indeed remove the impossibility" (Sen, 1982a, p. 24). Yet, while such comparisons, or other techniques using irrelevant alternatives, may prove helpful for some specific choice situations, social or otherwise, they are necessarily tied to those situations and cannot be carried to context-free choice.

(vi) The use of individual utilities instead of preference orderings is sometimes thought as a way to avoid the impossibility result. Yet, "without interpersonal comparability [cardinal individual utility functions] has no effect on Arrow's impossibility result" (Sen, 1982a, p. 24; 1986, p. 1115). As Arrow himself comments, the very possibility of a cardinal measure is incompatible with the requirement of Condition I:

> "Any cardinal measure, any attempt to give a numerical representation of utility, depends basically on comparisons involving alternative actions which are not, or at least may not be, available, given the environment prevailing at the moment" (Arrow, 1967, p. 113).

Thus, the use of cardinal utility functions, which is justified under some conditions,[22] is not a counter-example to AMTIT, precisely because of the appeal to these justifying conditions is necessary and these conditions are context-sensitive by their nature.

(vii) Choice rules like maximin (maximizing of the welfare of the worst-off individual which is taken as the welfare of the society) and leximin (the lexicographic version of maximin) gained some philosophical interest in the recent years.[23] These rules are not counter-examples to AMTIT. In the abstract it is not clear at all why the overall consideration ("welfare") should be identified with the welfare of that dimension whose welfare is minimal among all the dimensions. Why should not the overall consideration be based on equal treatment of all the dimensions? Moreover, the meaning of the "welfare" of a dimension is lost when the dimensions are not restricted to different individuals -- as it is in social choice and welfare economics. When the color of new cars is a dimension as well as the number of seats, their type, the power of the motor etc., the "welfare" of a dimension, and the "worst-off" dimension are clearly senseless. It makes sense to speak about the welfare of the individuals, because in some substantive-moral sense, to which there is some prior (if implicit) commitment, the different dimensions of a society, i.e., its individual members, are regarded equal. Because of it, it is possible under some conditions, to construct measures of welfare which apply to all the dimensions (individuals). In the general abstract case, this does not hold. Dimensions may be different and even non-comparable. This by itself, shows the context-dependency of maximin and leximin.

Moreover, there are strong arguments that what should be at the center of our concern, at least in some specific situations, is neither the concern for the weak nor for the equitable, but the concern for the largest potential for growth. Hirschman's argument for non-balanced growth provides an example (Hirschman and Lindblom, 1962). Hirshman's example shows that the interest of increasing the social wealth may involve a viewpoint which is different then that of distributing existing social wealth. This is another form of context-sensitivity.

This concludes the discussion of some of the attempts to prove positive possibility theorems. In all the cases of positive possibility it was found that they involve, in one way or another, violations of at least one of the requirement of context-insensitivity. In addition some Arrovian impossibility theorem were also touched upon. As Kelly (1978, p. 3) puts it:

> "for each of Arrow's conditions there is now an impossibility theorem not employing that condition."

2.4.3.5 **"Arrow's conditions cannot serve as the basis for general choice theory or as a theory of rationality because they are controversial."** In addition to what is said above the following may be added:

Arrow's conditions can serve as a basis for a general, context-free choice theory adequate for the generalized choice structure, because they indeed happen to express a mata-theoretic insight within the framework of welfare economics. The impossibility is primarily a meta-theoretic impossibility. The social choice impossibility, formulated and proved by Arrow, is but a reflection of the meta-theoretic impossibility.

The controversies which have accompanied Arrow's impossibility theorem are about the descriptive and the normative adequacy of Arrow's conditions in the domains of welfare economics and social choice. I.e., whether these conditions are true as statements of welfare economics or should be required from any aggregation scheme of preferences, are indeed open issues which have to be settled by the researchers in these fields. Whether or not they are justified as conditions for any context-free choice theory adequate for the generalized choice structure, is independent from their adequacy within welfare economics. It is to be settled by the soundness of the arguments brought above (2.2.1-2.2.8). As a meta-theoretic theorem AMTIT is not vulnerable to the controversies concerning the relevancy of Arrow's theorem to welfare economics or any other branch of science. It can only be vulnerable to criticisms that it is not sound, i.e., that the conditions CF1-CF8 are not justified or that the derivation of AMTIT from these conditions is not valid. It is enough for CF1-CF8 that they are relevant and justified in one domain, namely that of context-free choice theories adequate for the generalized choice structure. To be relevant and adequate in any other domain, such as welfare economics, is only a bonus which is indicative of the extent to which context-free choice is reflected in that domain. The message of AMTIT, that there is not any context-free choice theory adequate for the generalized choice structure is rather independent from the issue whether the axioms of AMTIT, when interpreted in the domain of welfare economics are indeed relevant and adequate for welfare economics. That their adequacy for welfare economics is controversial does not affect their usefulness, and even necessity, for a general theory of choice, as conveying the idea of a context-free choice theory adequate for the generalized choice structure.

2.4.3.6 **"AMTIT does not add anything, it is only a cumbersome reformulation of Arrow's theorem."** At this stage of the discussion it can easily be recognized that AMTIT has a "life of its own." From logical and methodological viewpoints there is a sharp difference between Arrow's impossibility theorem and AMTIT. This is seen immediately when the intended interpretations of Arrow's theorem and AMTIT are compared.

Arrow's impossibility theorem speaks about social welfare functions which maps n-tuples of individual orderings over a set X of alternatives into an overall social ordering of X. The domain of the intended model of Arrow's impossibility theorem, i.e., the intended interpretation of X, is a set of sccial states. A social state is characterized by Arrow (1963, p. 17) as:

> "a complete description of the amount of each type of commodity in the hands of each individual, the amount of labor to be supplied by each individual, the amount of each productive resource invested in each type of productive activity and the amounts of various types of collective activity, such as municipal services, diplomacy and its continuation by other means, and the erection of statutes to famous men."

AMTIT, on the other hand, speaks about theories of choice. The domain of a model of AMTIT is a set of choice theories (maybe a singleton) which in their turn may have a diversity of models in a multitude of areas. The sets comprising domains of models of choice theories (themselves possible models of AMTIT) are required to be such that they are finite sets containing at least three members (alternatives) from which a choice has to be made based on, at least, two dimensions along which the alternatives are judged. Thus, the following can serve as domains for models of choice theories which may populate the domain of a model of AMTIT; a set of social states or a set of development projects (for a corporation or for a nation-state); a set of theories relating to some domain or of methods for selecting theories; a set of methods for solving practical problems, such as financial management or maintenance practices, or of methods for theoretical problems, as heuristics for proving mathematical theorems; a set of maxims of moral conduct or alternative transportation plans for some metropolitan area.

The power of AMTIT is illustrated by its ability to settle decisively the issue of the possibility of a pure concept of rationality. A pure concept of rationality can be characterized by the following four features (Suppes, 1960, 1980): (i) it pertains only to the mental machinery of the decision-maker, therefore (ii) it does not relate to any specific features of the decision situation, and thus it does not lay any structural conditions on the environment of the decision, thus (iii) it is applicable to all choice situations, and (iv) the maxim of decision making is derivable from it, and thus it leads to a choice in every decision situation. A theory of a pure concept of rationality uses axioms of pure rationality but not structural axioms. Pure rationality axioms are those "which should be satisfied by any reflective man in a decision-making situation" (Suppes, 1956, p. 67). Pure structural axioms "postulate some special structural properties on the environment," and each of them is thus "a structural imposition on the range of applicability of the theory" (Suppes, 1960, pp. 164-5). Suppes discusses the (recursive) axiomatizability of a simplified model of pure rationality, using strong model-theoretic means (1960). He concludes that even for the simplified model "the problem of finite axiomatization is not settled"

(p. 167), and in general:

> "the problem of finding a reasonably appealing recursive axiomatization is difficult. A fortiori these problems are unsolved for models which permit more states of nature" (p. 168).

It is significant that Suppes (1980), which discusses the issue of a pure concept of rationality, does not contain any new results concerning the construction of a theory of pure rationality.

AMTIT settles the issue of the possibility of a pure concept of rationality decisively, in the negative. A pure concept of rationality without any structural constraints, which is universally applicable, would have been a counter-example to AMTIT. If a concept is a pure concept of rationality, then it has to be context-free. Otherwise it relates not only to the "mental machinery of the decision-maker" but also to the environment of choice. If it is universally applicable it must also be applicable to the generalized choice structure. But then it would be a counter-example to AMTIT, which is impossible. Therefore, a theory of a pure concept of rationality is impossible. To reach this strong negative conclusion AMTIT uses rather weak means compared to the model-theoretic means used by Suppes (1960) which could not lead to a conclusive answer.

2.5 CFR (Context-Free Rationality) is Not Adequate for Policy Theories

As mentioned above there may be two defenses for the thesis that RVR (the received view rationality) is adequate for policy theories.

According to Defense 1, ideal RVR is adequate for policy theories because it is context-free and hence universally applicable. According to Defense 2, RVR is applicable to policy theories because of reasons which are specific to policy theories.

If RVR is ideal and so context-free (and because of this it is applicable to policy theories and issues) then it is a counter-example to AMTIT. Therefore, it is not possible and hence the universal applicability of RVR cannot be based on it. Therefore, Defense 1 is rejected.

The ground is now prepared for the examination of rationality theories through their adequacy to actual cases in the policy sciences. The examination begins with a critique of RVR in general.

NOTES

(1) "In almost all the environments in which we are forced to chose an act, the set of acts or decisions open to us is small, and the events that we consider relevant are small in number" (Suppes, 1980, p. 182). Moreover, because of its negative nature, the concentration on finite structures does not restrict the generality of the argument.

(2) For the other congruence axioms and the relationships between them and preference relations see Sen (1971). See also note (16) below.

(3) Indeed, once it is admitted that any theory can have other models in addition to its intended model the determination of its interpretation is something that has to be done outside the theory itself. An argument for this point related to utility theory is given in Tversky (1975) especially pp. 170-173.

(4) According to the Talmudic Law, if each one of the judges sitting in the Great Sanhedrin sentence an indicted person to death, then this person is set free (Sanhedrin, 17A). But clearly this is an example of a context-dependent rule. For in cases involving other penalties unanimity wins.

(5) If an agent's preferences are cyclic a shrewd operator can persuade him to pay some money in order to attain that which is higher in preference. This process can be continued in as many steps as needed to drain the agent's monetary resources, because of the cyclicity of the preferences. See Davidson et. al. (1955, p. 164) for the argument. The term "money pump" was given by Tversky.

(6) For the history of impossibility theorem see also Arrow's introduction in Arrow (1983).

(7) As cited in the second motto for this chapter, Arrow himself diagnosed in 1972 the philosophical implications of his theorem as not clear and as a challenge.

(8) A broad characterization of welfare economics is the following:

> "Welfare economics is the study of the well-being of the members of a society as a group, in so far as it is affected by the decisions and actions of its members and agencies concerning economic variables.

Welfare economics is concerned with such issues and attempts to shed light on the relative merits of different forms of organization of the entire economic system as well as the issues involved in a particular decision to be made by government." (Winch, 1971, p. 13)

Another is:

"The objective of welfare economics in the evaluation of the social desirability of alternative economic states." (Henderson & Quandt, 1958, p. 201)

(9) See for example, Samuelson (1947, p. 223).

"A more extreme assumption, which stems from the individualist philosophy of modern Western Civilization, [sic] states that individuals preferences are to 'count'."

"Thus the economic theory currently designated as 'microeconomics' ... analyzes economic phenomena in terms of assumptions concerning the economic preferences of individual procedures of economic goods ... The objectives of microeconomics are therefore in complete accord with the program of methodological individualism." (Nagel, 1961, p. 543)

See also Deane (1978).

(10) This formulation is close to the so-called Bergson-Samuelson formulation. Arrow went one step further by postulating that the society's choices as a whole should be determined by an ordering. Arrow's social welfare function is a function which maps n-tuples of individual orderings of social states to an ordering of these states which expresses society's preferences. See Sen (1986, pp. 1073-1077).

(11) Arrow (1951, 1963) calls it the General Possibility Theorem. Later the theorem which states an impossibility became known as Arrow's Impossibility Theorem. See also Sen (1986).

(12) Several formulations of the theorem can be found in the literature. Some of these are surveyed in Fishburn (1973) and Sen (1986). The formulation given here follows Fishburn's (1973) and Sen's (1977, 1986). There are several proofs of the theorem. A relatively informal one is given in Arrow (1963, 1967). For other proofs see Fishburn (1973, Ch. 11); Sen (1986, p. 1080). See also Kelly (1978).

(13) As stressed by McClennen (1983, pp. 345-346), Arrow's theorem can be seen as a variation on a more general theorem, proved in Blackwell and Girshick (1954), on ordered vector spaces. See also Luce and Raiffa (1957, p. 368). Schwartz (1970) presents several interpretations of Arrow's theorem as relating to multi-attributed alternatives of various sorts, including decision making under uncertainty and under risk, as well as moral decision making and collective decision making.

(14) See Kelly (1978); Mueller, D. C. (1979); Sen (1986).

(15) E.g., MacKay (1980); Machan (1980).

(16) Other versions of AMTIT, i.e., the impossibility of a context-free choice theory adequate for the finite generalized choice structure, can be proved. These versions result when different conditions are used instead of CF1-CF8. For example the Partial Congruence Axiom can be substituted in CF2 and CF5 by the Weak Congruence Axiom (Sen, 1971). This axiom says that, "If xRy, then for any S in K such that $y \in C(S)$ and $x \in S$, x must also belong to $C(S)$." By substituting "$x \in C(\{x,y\})$" for "xRy" the axiom is reformulated solely in terms of choice functions. Violations of this axiom can be justified only by context-sensitive considerations. Otherwise the expansion of S should not change choice priorities. As proved by Sen (1971, p. 301), this axiom implies that the revealed preference relation R_r (2.1.8 above) is an ordering. Thus, it can be used. The advantages of the Partial Congruence Axiom are that it conveys more clearly the idea of being context-free, and that it is weaker than the Weak Congruence Axiom.

(17) Positive possibility theorems state that under some specific conditions it is possible to have an aggregation scheme for preferences. Such schemes which give a social (an overall) preference relation for n-tuples of individual (dimensional) preference relations are called relational collective choice rules. Those which give a social (an overall) choice function for n-tuples of individual relations are called functional collective choice rules. Arrow's welfare function, f, (2.3.2) is an example of a relational collective choice rule (Sen, 1977, 1986).

(18) For details see Sen (1977, pp. 166-169; 1986, pp. 1084-1089).

(19) This theorem is due to Gibbard "in a regrettably unpublished paper" from 1969 (Sen, 1977, pp. 166-167).

(20) E.g.,

> "We feel that the weakest link in the development is the axiom of independence of irrelevant alternatives, and we support this

> contention by presenting counterintuitive examples" (Luce and Raiffa, 1957, p. 368).

A more recent comment on the independence condition as a target of criticism is made by Kelly (1978, p. 3).

> "For economists and social thinkers not intimately aware of very recent collective choice theory, the standard reaction has been to point to <u>one</u> of Arrow's conditions (usually but not always, the one called 'independence of irrelevant alternatives') and, by denying its reasonableness as a formalization of an ethical precept, dispose of Arrow's theorem as a barrier to welfare theory. The difficulty this reaction now faces is very simple: <u>for each of Arrow's conditions, there is now an impossibility theorem not employing that conditions</u>."

(21) See also Fishburn (1973, 1974).

(22) For finite structures there is not one set of necessary and sufficient conditions for the existence of cardinal utilities. Fishburn (1970) presents several existence theorems for some specified cases which state the required structural conditions for those cases, respectively. For example, Theorem 4.1 (p. 44) for additive utilities; Theorem 6.1 (p. 83) for preference-difference comparisons.

(23) The interest is the maximin, leximin and similar conditions gained momentum following their role in Rawls' (1971) work on justice. See Sen (1986, pp. 1114-1121) for a discussion of their axiomatic derivations.

Chapter 3: RVR is not Specifically Adequate for Policy Theories

> "I use the term 'classical empiricism' to describe this fascinating, tortuous, schizophrenic combination of a conservative ideology and a progressive practice." (Feyerabend, 1970, p. 151)

We turn now to Defense 2, which claims that there are reasons, specific to policy issues, which make RVR adequate for policy theories. This defense is refuted by both philosophical arguments and an analysis of the situation in the policy studies. The philosophical arguments show that RVR, or RVR based theories, cannot meet some adequacy requirements. These requirements are not dependent on any particular R-concept or policy theory. Among these requirements the following can be found: (i) Any adequate R-concept should be such that policy theories built upon it should have the capability to learn from experience that the particular R-concept employed is deficient. In other words, it should be possible to learn from experience that an R-concept is inadequate. (ii) An R-concept should be such that it enables a characterization and theoretization of policies. (iii) It may be the case that policies, in contrast to some decisions, are sensitive to organizational factors, in any one of the phases of deliberation, decision, actions and monitoring of results. If it is so, an adequate R-concept should be sensitive to these organizational factors. (iv) Whatever policies are and whatever the R-concept, an R-concept adequate for policy theory should be capable of handling all the kinds of uncertainties which may be relevant to policies. Because, as I shall argue, these criteria are not met, defense 2 fails.

The situation in the policy sciences literature echoes the philosophical arguments. In particular an interesting situation can be discerned in that literature. Policy failures are regarded as due to poor implementation, but not to possible inadequacies of the R-concept itself. Moreover, some writers provide detailed examples which show that policy studies which are based on the RVR do not and can not succeed. Some writers recommend and carry out measures that outstep RVR. Nevertheless, RVR is repeatedly presented in textbooks and reviews as the rationality concept which is appropriate for policy theories. Various attempts made by philosophers and policy scientists to present alternative concepts of rationality seem to have no effect. This mess seems to be an instance of what Feyerabend has diagnosed as "a conservative ideology and progressive practice."

This mess is an inherent characteristic of RVR. It stems from the fact that RVR has simultaneously choice theoretic, rationality theoretic and epistemological (meta-rationality theoretic) functions. Because of this feature arguments against RVR based theories on the theoretic level, based either on theoretical considerations or on experience gained from applying it in practice, do not lead to a change in the R-concept itself. This happens because of the epistemological function of RVR. Thus it tends to become immune: once adopted, difficulties in applying RVR are seen as due only to poor implementation.

On the basis of these considerations RVR is found not to be specifically adequate for policy theories. By this both defense 1 and defense 2 are rejected. Therefore, Thesis 1 is rejected.

3.1 Philosophical Arguments Against Defense 2

Characterizing policies is deferred until an R-concept adequate for policy theories is explicated (Chapter 1 above). Therefore the claim that RVR is specifically adequate for policy theories can only be appraised against some adequacy criteria. An attempt should be made to ensure that these criteria do not presuppose any R-concept or a theory of policies. Such criteria have emerged during the discussion above.

3.1.1 RVR Tends to Lack Criticizability by Practical Experience: The Rational Critic problem (1.3 above), how is it possible to rationally criticize an accepted R-concept, gives rise to an adequacy requirement which deals with second-order rationality. As argued in 1.3, a theoretically based criticisms of an R-concept must be an internal one. Internal criticisms, by their very nature, can expose formal and informal inconsistencies and fallacies. But when a coherent R-concept is applied within its intended domain of application, internal criticism is not enough. For assume that the results of repeated applications of an R-concept are evaluated as bad results. Internal criticism can say nothing in this case. Two possibilities remain. Either it is agreed that the R-concept in question is not criticizable, that it is either adhered to or not as a matter of faith,[1] or it is taken as an adequacy requirement that an R-concept should be such as to make itself criticizable on the basis of practical experience, as well as on the basis of theoretical considerations. In the first case, where the R-concept in question is not criticizable on the basis of practical experience, or in other words, where it lacks second order rationality, we have irrational rationality. In the second case, where second order rationality is a prerequisite, we have a possibility to adhere to some particular R-concept on rational grounds, and not only on faith. So, having the Criticizability on the basis of Practical Experience (CPE) property is taken as an adequacy requirement for an R-concept adequate for policy theories.

RVR tends to lack the CPE property. For, as explained in Chapter 1, the individuals which an RVR based policy theory refers to must be choices. It is so stipulated by the instrumental component of RVR. According to it, what can be properly predicated as rational (or irrational) are instrumental choices (1.3.2) where an instrumental choice is a selection of a means from a given set of means in order to efficiently achieve some given objective(s). These choices are supposed to be made in a formal mode (the second component of RVR). Besides the constitutive function (which determines the individuals referred to by a policy theory which incorporates it) and the theoretic-normative function (which determines how policies are to be made, i.e., as some choices of a best, or at least better, means to some given end), RVR, as an R-concept (1.3) has an epistemological, or meta-theoretic normative function. This last function determines that the R-concept which should be used by a policy theory is, indeed, RVR. Now assume that the results of applying an RVR based policy theory to some policy issues is found deficient, wrongheaded or even fatal. Can RVR be criticized on the basis of such practical experience and found deserving some modifications, revisions, or substitution? The answer tends to be negative. As long as RVR is not discarded, its epistemological, i.e., second-order normative,[2] function on the level of meta-rationality theory dictates that the R-concept which should be used on the level of rationality theory is RVR itself. Bad results tend to be seen as attributable to poor implementation, rather than as due to or expressing any deficiencies of that R-concept itself.

3.1.2 RVR Prevents Insightful Characterization of Policies: For an R-concept to be adequate for policy theories it has to enable an illuminating and fruitful characterization (and theoretization) of policies. Without a fruitful characterization of policies, i.e., of those individuals referred to by policy theories, it is not possible to gain insight into and understanding of the making, implementing, monitoring and rethinking of policies. Thus, it is taken here as an adequacy requirement that an R-concept adequate for policy theories should make room for insightful characterization of policies.

When RVR is adopted no broader and more enlightening characterization of policies can be given except to see them as some kind of choices (see 1.3 above). As a result of the constitutive (ontological) function of RVR, as an R-concept, whatever is predicable as RVR-rational is an instrumental choice. But to say that a policy is an instrumental choice and nothing more is neither illuminating nor fruitful. It is not illuminating because it simply rehearses the adopted R-concept, and maybe there is more to policies than choices. If this is the case, then adopting RVR is counter productive because capturing and theorizing these other, or additional, features of policies is prevented by the very adopting of RVR. Thus, adopting RVR is an obstacle to recognizing the other facets of policies, beyond choices. It is not fruitful because being an instrumental choice is a rigid structural concept. It is not amenable to superpositions. Any other structure suggested for characterizing policies, has to be compatible with their being choices. All that can be hoped for is to discern some sort of choices. Because of the structural properties of being an instrumental choice it is also not amenable to remolding or to further construction and development. Thus, all that can be said about policies is, in effect, a rehearsing of their being RVR-rational. By this the chance to recognize other structural elements, if it is found necessary, is forfeited. Policy theories are forced into a rigid and not-illuminating form.

3.1.3 RVR Cannot Accommodate Organizational Aspects of Policies: What is usually called 'a policy' both in common-sense discussions and in the policy science literature is something which takes place by and within a highly organized entities. A priori it may be the case that the making of policies or policies as products, or both, may be sensitive to some of the organizational properties of those entities. If this is the case then an adequate R-concept should be such that it makes it possible to incorporate those factors into a policy theory.

RVR makes it impossible to include organizational factors in policy theories in any but a superficial mode. By the analytic component of RVR, comprehensive decisions are analysed to a number of decisions of a lesser scope. These are treated separately and then recombined together to arrive at a solution for the original decision. The smaller decisions may be seen as those taken by lower echelons in organizations; the more comprehensive decisions by the higher levels. Apart from this, organizational factors can be treated, when RVR is adopted, only as external factors which exert their influence on policies from without. The effect of those "external" organizational factors are, so to speak, superimposed on the results of applying RVR on the problem under discussion. But it remains external. Internal superposition of concepts is prevented by the structural properties of RVR.

3.1.4 RVR Cannot Treat Adequately Endogenous Uncertainties: What is usually called 'a policy' has to deal with uncertainties of different sorts. Without being committed to any conceptualization of policies, it can be said that the environment in which and for which policies are made is characterized by a variety of uncertainties.[3] Among them are social and technological uncertainties, due to non-deterministic[4] and even non-continuous and unstable processes,[5] as well as partial knowledge and low predictive[6] capacity. The capacity to handle adequately all sorts of uncertainties is, therefore, demanded as an adequacy requirement for an R-concept suggested for policy theories.

Two kinds of uncertainties can be distinguished, exogenous and endogenous uncertainties (Kurtz, 1974). Exogenous uncertainties are those which are only related to the states of the world, as distinguished from the states of decision makers. The agent is uncertain which of the world-states actually obtains. Endogenous uncertainties are those which are not exogenous. Two kinds of endogenous uncertainties are discussed below. The first relates to the adequacy of the probability space, which is used to encode the agent's uncertainty, for this very task. The second is uncertainty about the performance of the agent's own organization. Arguments are presented below ((b) and (c)) to support the claim that these kinds of uncertainties, which, as will become evident by the examples in Chapter 4, are frequently present in policy issues, cannot be accommodated by the RVR-based models of decision. These arguments are preceded (a) by a brief discussion of the way by which exogenous uncertainties are treated in models of this sort.

(a) Exogenous uncertainties are about the actual world-state which obtains. The set of possible world-states is known, but not which of its members is the actual one. Nor it is known with which probabilities these states are realized. In terms of the payoff matrix, which is the core of the representation of choices in non-certainty cases, according to RVR, (see 1.2.2 above) the exogenous uncertainty is expressed by uncertainty regarding which column is the one representing the actual world state. This kind of uncertainty can be handled in two ways:

(i) In the absence of (objective) probabilities over the states (which tell the relative frequency with which each of the states is actualized) subjective probabilities over the states are intuited. These are supposed to express the agent's degree of relative belief in the occurrence of each state (from the set of world states). Once these probabilities are intuited they can be used to calculate expected utilities for each feasible alternative (act). Moreover, the initial distribution of subjective probabilities can be improved by conditionalization on new information according to Bayes theorem (see 1.2.2 above). Thus by the use of subjective probabilities exogenous uncertainty is reduced to the case of risk, for which there are well-developed models of decision incorporating RVR as their R-concept (1.2.2 above).

(ii) For any model to serve as a decision model it has to include some decision rule. Such a rule specifies using those terms which are used in the particular model, how a (rational) choice is to be made from the given set of alternatives. When probabilities for the states are not available, the terms with which a decision rule for the uncertainty case can be specified are those of the payoff matrix itself. These terms are the various world states (the columns), the alternatives (the rows) and the consequences (the cells of the matrix). Also, in addition, utility functions may be defined over the consequences. Several rules are available for making decision under these conditions. Some of them are surveyed in 1.3 above. For example, the minimax rule according to which the selected alternative is one whose minimal utility of consequences (calculated across the various world-states) is the maximal (when compared over the given alternatives). This rules expresses a conservative attitude towards decisions under uncertainty. Other rules express different attitude. It is clear that these two ways ((i) and (ii)) of dealing with exogenous uncertainties are RVR-based. Both are instrumental and formal, i.e., they conceptualize decisions (under uncertainty) as a selection of a best means (i.e., an alternative) from a set of given means. The evaluation of attainment of the given ends is done by the values of the consequences (or of their utilities) of the alternatives, and it is done formally, i.e., without recourse to anything pertaining to the specific contents and contexts of the specific decisions. Only the terms of the payoff matrix (which is a formal construct) and subjective probabilities for the states (in (i) above) are used in the respective decision rules. Thus it is seen exogenous uncertainties can be accommodated by RVR-based models of decisions.

(b) Uncertainty concerning the adequacy of the (subjective) probability space which is used to represent the agent's uncertainty is the first kind of endogenous uncertainty to be discussed here. As argued by Suppes (1966), (1979), (1980), a

Bayesian viewpoint does not and cannot incorporate a theory of concept formation. Bayesian theory enables a decision maker to modify an initial subjective probability distribution, which he has concerning a decision situation confronting him, by conditionalizing it on new information according to Bayes theorem. But when the situation is such that it is appropriate to view it in a radically different way, by the use of relatively novel concepts, then Bayesian theory is short of being able to handle it.

> "The [Bayesian] theory is static in the sense that it is assumed the decision maker has a fixed conceptual apparatus available to him throughout time." (Suppes, 1966, p. 21)

The need to change the conceptual apparatus may arise when there are discontinuities and instabilities (Suppes, 1985) in the situation, or when the initial conceptualization of the situation calls for some major modification, or is simply wrong. Technically, the conceptual apparatus of the decision maker determines the states of the world which are representable in his model. What prevents the introduction of novel concepts, is that the probabilities distributed over the states of the world which correspond to the initial conceptual apparatus (i.e., the available predicates), must sum to one. There are not, so to speak, "additional probabilities" to be given to states of the world corresponding to novel concepts. Thus, Heraclitus' dictum

> "Unless you expect the unexpected you will never find [truth] for it is hard to discover and hard to attain." (Wheelright, 1966, p. 70)

frustrates Bayesian theory, the paragon of RVR-based models for uncertainty conditions.

Whatever policies are, it seems that policies should be capable of handling discontinuous situations. By combining Suppes' result with Heraclitus' insight the following conclusion is arrived at:

> An attempt to expect the unexpected is necessary, at least for handling discontinuous situations. Bayesian models of decisions are inappropriate for this task.

Thus we see that this kind of endogenous uncertainty cannot be adequately treated by a relevant sort of RVR-based models of decision.

(c) Uncertainty concerning organizational characteristics which are relevant for policies: Decisions are affected by organizational characteristics of the units for which and by which they are made. If policies can be handled by RVR-based models they have to be conceptualized as some kinds of decisions. Indeed, in cases of what is usually regarded as "policies" the decision maker is a unit which has organizational features. Frequently it is a small group served by a somewhat larger organization, and it makes policies for a more comprehensive organization (or at least a body with some measure of organizational (institutional) characteristics). Thus public policy can be made by a small group of decision makers and served by an internal or external consulting organization for the particular Office or Department, or for the nation (the state) as a whole.[7] The decision maker (the small group) referred to above may happen to be uncertain concerning his (its) organization (or concerning that part of the organization which is involved in the making or implementing of policies). These uncertainties may be regarding cognitive characteristic -- like the treatment of information of all sorts -- in terms of capability, determination or reliability. These uncertainties may also be regarding the integrity of key personnel, or regarding the effectiveness and reliability of the organization's structure and operating procedures.

Endogenous uncertainties of these and similar kinds cannot be adequately handled by RVR-based models. Arguments are presented to show that neither of the approaches of handling (exogenous) uncertainties in RVR-based models can do for organizational endogenous uncertainties.

(i) The first approach for handling uncertainties is Bayesian decision theory. In Bayesian theory what is required is to have subjective probabilities over the states in the payoff matrix. But whereas in the treatment of exogenous uncertainty the relevant states are world-states, the states required for endogenous uncertainties are internal states of the organization (or some mixture of organizational and world states). The difficulty arises because organizational states include actions (or their results) overwhich the decision maker has (at least some) control. In other words, organizational states are at least partially determined by actions which can be taken by the organization. But this is the issue of having subjective probabilities for acts! As argued by Spohn (1977) subjective probabilities for acts should not be contained in any adequate quantitative decision model. For it is rather absurd for the agent to ask himself what is his partial degree of belief that he will choose some particular act from among those available to him. When it is agreed with Spohn that subjective probabilities for acts should be rejected then subjective probabilities for organizational states should fare the same. Thus, organizational endogenous uncertainty cannot be adequately treated by Bayesian theory, the relevant sort of RVR-based models.

This negative result remains untouched under the various ways open for representing organizational states within RVR-based models. These include the following: (1) Organizational states are represented by an additional payoff matrix. In this case subjective probabilities have to be generated over the organizational states. But these probabilities have been shown to be subjective probabilities for acts. Thus, they are absurd. (2) Organizational states are represented within a unified set of states together with world-states. But then each state is a complex of elements some of them are elements of the external world and some internal to the organization. But then the same difficulty of subjective probabilities for acts arise again. (3) Organizational uncertainties are supposed to be taken care of by a two staged process. But then the following emerges: For each organizational state, a payoff matrix conditionalized on it is built.

An act is chosen by subjective probabilities for world state and the agent's preferences. The product of this stage is a list of best alternatives (acts) under (or conditionalized upon) the various organizational states. There is some uncertainty concerning which organizational state actually holds. The agent has to choose now an act facing this uncertainty. This is the second stage. But how can he do it? If by generating subjective probabilities for the organizational states, then we face again the case of subjective probabilities for acts. If one of this organizational states is declared "optimal" and an act found best under it is implemented, new difficulties arise. First, if the actual state differs from the optimal one, then choosing an act which is best under the optimal state can lead to disastrous results. What is best in the best of the worlds is not necessarily the best in all of them. (Usually, it is rather bad in many of them). Thus, choosing an act which is a best one under the optimal organizational state is not guaranteed to be in the best interest of the agent. Therefore, it cannot be regarded as RVR-rational. The agent's problem remains how to choose an act from that full list of best acts under the various organizational states which are uncertain. And the selection of an act has to be made by RVR, not arbitrarily. (The suggestion that this second stage should be done according to some decision rule under uncertainty is discussed below.)

Second, it may be claimed that in the first stage the agent eliminates his organizational endogenous uncertainties by taking various organizational measures aimed at improving the procedures and structures of his organization. By doing this his problem is reduced to a choice under exogenous uncertainty. That choice is supposed to be made by some RVR-based model in the second stage. The trouble with this suggestion is that it cannot be done. No matter how hard an agent will try along such lines, two factors are against him. The one is the law of diminishing returns. The marginal return of any effort to improve the organizational state decreases. Multiple efforts too are subject to this law. The required efforts for eliminating organizational endogenous uncertainty may exceed the agent's capabilities (in terms of material, financial, human and managerial resources). Also, the time required for organizational improvement and for the complete elimination of endogenous uncertainties may exceed the time frame for the intended decision. Thus it cannot be guaranteed that the attempt to reduce the case of endogenous uncertainties to that of exogenous uncertainty (which can be treated by RVR) can succeed. Because of the failure of this alleged reduction by way of organizational improvement it cannot serve as a basis for the claim that RVR is suitable and sufficient for the case of organizational uncertainties.

(ii) The second approach to decision making under uncertainty which is guided by RVR is the use a decision rule specifically designed for these kind of decisions (see 1.2.2 above). This approach too leads to absurdities when the relevant uncertainties are organizational endogenous uncertainties. Whether the decision rule expresses pessimistic attitude (maximin) or an optimistic attitude (maximax) or some intermediate position (Hurwicz's criterion) (Luce and Raiffa, 1957, 278-294), when applied to organizational uncertainties it leads to absurdities. Also, it does not matter whether that which is maximized (or minimized) by the rule is utility (of consequences) or risk or regret. The arguments are as follows: First, we take maximin. This rule says in effect that the decision maker should choose that act whose minimal consequence (in terms of utilities) is the maximal (among all acts). Essentially the same rule is the central decision rule of game theory (Luce and Raiffa, 1957, Ch. 4). The leading idea of both rules is the maximization of the agent's security level. Associated with each act is the worst consequence that can happen in case that act is chosen. This is the security level of that act. Nothing worse than it can happen in case this act is chosen. Because both rules, the one of decision making under uncertainty and the other, of game theory, can be seen as about the maximization of the agent's security level, decision making under uncertainty can be regarded as "Games against Nature" (Milnor, 1954; Luce and Raiffa, 1957, chap. 13). If a decision maker uses the maximum rule when faced with organizational endogenous uncertainties he can be regarded as playing a game against his own organization. And a strange game it is. For he is seen now to maximize the minimal utility which may accrue (when any act is chosen) because of the acts of his own organization. But this approach is absurd. It means in particular that no executive can rely on that part of the organization over which he presumably has authority. On the contrary, he has to treat the lower levels which report to him as opponents. But this means that no organization is possible; society has to be regarded only as a collection of atomic units. For if for every executive in any organization, the lower levels (of the organization) which report to him have to be regarded as opponents of him, then there is no difference between these lower levels and what is usually regarded as external to the organization. Thus, organization withers away.

A possible objection to this argument is that it is based on a decision rule for cases of pure conflict. Organizations have to be regarded as partly conflictual and partly cooperational entities. Decision making in face of organizational endogenous uncertainty is possible when a decision rule for mixed conflict-cooperation situations is used. But this objection only reinforce the claim that organizational uncertainties cannot be handled by RVR based models.

For the determination of which decision rule is adequate for the specific case of part conflict and part cooperation cannot be done by reference to formal canons only. It must be made by some assessment of the kind and the degree of relative conflict and relative cooperation. It requires judgments which cannot be captured by RVR; judgments which exceed the formal-instrumental-analytic character of RVR.

Using the maximax rule (i.e., choosing that act whose highest consequence in terms of utility is maximal (across all the acts)) also leads to difficulties. With regard to the personnel of the organization, it in fact denies the very existence of organizational uncertainties. For it treats the organization in a diametrically opposed way to the maximin rule. The organization is seen as helpful and cooperative. If it is maximally helpful and cooperative then there is no endogenous uncertainty concerning the determination and reliability of the organization's personnel. With regard to organizational capacities for making and implementing decisions it is hyper-optimistic. Indeed it is a case of wishful thinking and denial of reality. Rules, which are combinations of these two rules suffer, to some degree, both kinds of difficulties. The rule of insufficient reason is used to lead to unified probability distribution. But in the case of endogenous uncertainty these probability distributions are subjective probabilities for acts. The difficulties associated with them have been discussed above.

The arguments hold for the case of the two stages procedure discussed above. In the first stage, best acts conditionalized on the various organizational states are supposed to be determined by Bayesian decision theory. The second state is supposed to be made by using some decision rule under uncertainty. We face either a no-organization or a no-organizational uncertainty position. The first position is behind the maximin (utility) or minimax (loss rule. The second position accompanies the maximax rule.

To sum up: The use of the RVR-based models under conditions of organizational endogenous uncertainties cannot succeed. It leads either to absurdities (of generating subjective probabilities for acts which are at least under partial control of the agent, or the denial of the organization itself) or to a commitment to the over-optimistic rule of maximax which only makes sense when endogenous uncertainties are not present. It has to be noted that the same arguments hold whether the value of the consequence in the payoff matrix is expressed in terms of utility, disutility (loss) or regret. For they only depend on relationships between the decision maker and his organization (and not on how to gauge consequences). Thus, RVR-based models are not adequate for the treatment of organizational endogenous uncertainties.

One remark before this section is concluded: ..e arguments above are not intended to support a claim that endogenous uncertainties cannot be dealt with, and they do not do it. The claim is made here, and which, hopefully, is supported by these arguments is that the treatment of these uncertainties cannot be made completely by means of RVR. There are endogenous uncertainties, they must be treated and they are treated. The conclusion of the arguments given above is that accounting for them necessarily exceeds RVR.

3.2 The Situation in the Policy Science Literature Echoes the Philosophical Argument

The policy science literature provides examples of counterparts to the philosophical argument presented in 3.1. Some of these examples are described below. The overall picture which emerges is bewildering. There is an ambivalent attitude towards the role of RVR in policy theories. Although its inability to serve as an R-concept in policy theories is recognized, it is still advocated as the R-concept for policy theories. Instead of providing a theoretization of policies, an effort is made to surpass the need to characterize policies. It seems that Feyerabend's judgment concerning classical empiricism (Feyerabend, 1970, p. 151), "conservative ideology and progressive practice" holds for the situation in the policy sciences.

Each of the following subsections contains a thesis about the situation in the policy sciences and some examples. Together they substantiate the claim that the situation in the policy sciences literature reflects the abstract philosophical arguments brought above.

3.2.1 **Policy Failure are Common and Recognized:** The phenomenon of policy failure is common. Policy scientists acknowledge the occurrences of policy failure and take them as deservi g explanations. Some typical examples are given below. The British journal Omega dedicated one of its issues to Public Sector Decision Making. The first sentence of the editorial read as follows:

> "Everyone is aware that there is something rotten in the state of the United Kingdom as far as public expenditure and taxation are concerned." (Pearce, 1979, p. 379)

It need not be added that the British are known for their use of understatements ...

From the other side of the Atlantic the following judgment is issued:

> "In the United States solutions have often been announced ... [which] frequently seem to leave the situation worse off than if nothing had been done ... Dissatisfaction with the results of the decision making processes in use by government is apparent. Complaints about ineffective programs and wasted money are increasing." (Quade, 1975, p. 1)

The editors of a book dealing with the phenomenon of policy failures put their appreciation in blunt terms in the beginning of their introduction:

> "There is widespread concern that policies and politics are not succeeding." (Ingram and Mann, 1980)

Another policy analyst gives the following assessment:

> "During the period starting in the mid-sixties, one social program after another failed as measured by ostensible objectives -- and the failure was common knowledge. The remarkable thing was that the very professionals who ran programs, their clients, and interested parties, all acknowledged to themselves (and to others who were relevant) that these programs were unsuccessful." (Wildavsky, 1979,

p. 43)

Referring to this assessment by Wildavsky, Ingram and Mann have their grim opinion:

> "Current national politics [in the U.S.] seems unlikely to produce policy initiatives that will reverse these judgments." (Ingram and Mann, 1980, p. 11)

And in conclusion:

> "Diogenes notwithstanding, it appears easier to find an honest man than an effective program. Why? (Wildavsky, 1979, p. 4)

3.2.2 **Policy Failures are Considered Due to Human Performance**: When policy scientists attempt to answer why policies fail, they find themselves trapped by their conceptual framework. If the abstract argument in 3.1 is taken seriously, it can be expected that when RVR is taken as the R-concept for the policy sciences, then policy failures cannot be attributed to any other factor, but to human performance. Indeed, this is the explanation which is repeatedly given, in various formulations and under different titles.[8]

(i) "Excessive Policy Demand" Too much is demanded by the public from governments. Excessive demands breed failure. Human performances in placing such demands on governments predetermines failures of policies. Excessive demands explain and can be used to predict policy failures.

> "[T]he mounting demands placed upon modern government predetermine perceptions of failure ... Where the tasks set for government are so difficult, it is reasonable to expect a high rate of failure. (Ingram and Mann, 1980, p. 17)

(ii) "Realizable Expectations" Human beings demand too much. Human beings also have unrealizable expectations of the policies that governments initiate in response to those demands. Unrealizable expectations like excessive demands predetermines perceptions of policy failures.

> "The difficulties with policies often begins with the selection of unrealizable aims ...
>
> ... The goals of policies are often not what they seem to be ...
>
> ... Language in legislation is sometimes targeted toward making people feel better rather than causing events to occur ...
>
> ... [J]udging policies on the basis of original goals, that for a variety of reasons may be unrealizable, is probably not a fair test." (Ingram and Mann, 1980, pp. 19-21)

(iii) "Accurate Theory of Causation" Sometimes we have a wrong ratiocination, because of mistaken predictions due to a misunderstanding (all too human!).

> "... Policies may fail because linkages in the physical or the social system are not well understood.
>
> ... Without a better knowledge of physical relationships the selection of any policy is simply a gamble." (Ingram and Mann, 1980, p. 22)

(iv) "Choice of Effective Policy Tools" When the set of given means is a set of ineffective means -- such as incentives, disincentives, subsidies, regulations etc. -- it is a small wonder that chosen policies fail. That the set of candidate means contain ineffective means is attributable to human performance.

(v) "The Vagaries of Implementation" That the implementation of policies is bound to a vast source of difficulties, frustrations, caprices and failures is to be blamed on human commissions and omissions.

> "A great deal of modern policy depends upon a tangled web of federal, state and local agencies to realize policy objectives ..."
>
> "There are few hard and fast rules about what makes for successful implementation. Local factors ... have a strong and direct effects on outcomes. Many of these factors, such as commitment to policy and institutional support are difficult to quantify." (Ingram and Mann, 1980, pp. 25-26).

Clearly, "a tangled web," "a proliferation of veto or clearances points" (one of the examples given by Ingram and Mann), "commitments to policy" and "institutional support" are not part of the theory of rationality, given the adoption of RVR. They are connected to the failure of human performance.

(vi) "Failure of Political Institutions" Political institutions serve, among other things to connect policy makers with the public. When political institutions fail in this task, which happens time and again, policies are likely to fail.

> "Politics and policies are ... inextricably intertwined ...
>
> ... The choice of appropriate policy tools and oversight of the implementation process depends upon the sophistication and expertise of policy makers, as well as their dedication to making policies work. If concern with the substance of policy becomes less important then and unrelated to other matters such as reelection, constituency errands, expending agency budgets, and so forth, then policies are more likely to fail." (Ingram and Mann, 1980, p. 27)

Human individuals and human created institutions are prone to fail. Clearly this has to do with human performance, individually and collectively, and not with the RVR-based theory of rationality.

These are the classes of policy failures discussed by Ingram and Mann. The hypothesis that some of the failures may indicate difficulties within the conceptual framework used to discuss policies, does not arise. As argued above such an hypothesis cannot be made when RVR is the prevailing R-concept.

3.2.3 There is Some Awareness Among Policy Scientists that Applications of RVR to Policy Issues Neither Capture Nor Rationalize the Realities of Policy Efforts: Instrumental choice is a cornerstone of RVR. Indeed, RVR expresses the rationality of such choices. Strictly speaking, to apply RVR a comprehensive list of policy alternatives (i.e., all the means for attaining the given end) should be given. Only then can RVR be used to select an alternative which is maximal in terms of the given end. It is widely recognized[9] that if RVR is to be applied at all to policy issues, some modification of RVR needs to be done in order to arrive at a scheme which seems both to keep the spirit of RVR and also to be applicable to real world policy efforts. A standard scheme of this sort is presented below. It is followed by a discussion showing that there is some awareness[10] among policy scientists that even this modified version of RVR cannot rationalize real world policy efforts, and that attempts to apply it do not succeed.

A common scheme[11] of steps required for the application of modified-RVR to policy issues reads like the following:

(1) Perceiving a need, a problem, an opportunity, or an issue which requires treatment;

(2) Recognizing the relevant end(s) (which should be pursued in concern with the perceived need);

(3) Listing all the alternative policies for attaining these ends;

(4) Predicting the consequences of each alternative;

(5) Assessing the consequences of each alternative (for each interested group) in terms of those ends;

(6) Determination of relevant criteria for selection;

(7) Selecting a "best" alternative.

Recognition that steps (3), (4), (5) as stated are impossible appears already in Simon's classic of (1945). Simon is aware there that in reality "only very few of all these possible alternatives ever come to mind," that "knowledge of consequence is always fragmentary," and that imagination is required to substitute for the still lacking experience with future consequences, and that, thus, "values can be only imperfectly anticipated" (p. 81). Lindblom (1959) suggests his theory of incrementalism or successive limited comparisons, as an alternative for RVR-based theories of policies. Lindblom agrees with

Simon on the limits on subjective rationality. He adds that empirical and evaluational components are intertwined in the selection of goals; that means and ends cannot be separated; therefore, a search for a "best" policy is also meaningless and not only impossible; that consensus concerning policies is the ultimate criterion; that the process should be done successively to reduce reliance on theory. Notwithstanding the criticisms[12] of Lindblom's position, it shows some awareness of several difficulties with the applicability, and hence, the appropriateness of RVR to policy issues.

Current awareness of the inappropriateness of RVR is documented in e.g., Edwards and Sharkansky (1978); George (1980); Wildavsky (1979); to mention but a few. It seems that none of the steps of the standard scheme can be taken a given. There is some awareness that each step requires considerable efforts, partly conceptual, in which judgment and imagination are vital. Perception of a problem is not passive; the "real nature" of the issue which deserve some policy intervention, is not simply "out there."[13] Ends should be questioned, scrutinized, traded against each other and against resources, consolidated and agreed upon.[14] Alternatives should be generated and it has costs in terms of resources and human attention and imagination.[15] Prediction and forecasting, especially concerning policy issues, are not only costly but inherently uncertain and partial.[16] Assessment of future values is costly, uncertain and speculative.[17] Determination of relevant and appropriate criteria is complex and cannot be separated from prediction and valuation and is not independent from the alternative considered.[18]

others.[25]

The endogenous uncertainties cannot be treated by a selection of some alternatives which are free from them because the whole process is under the spell of these uncertainties. So the issue of meta-policy making[26] (i.e., a policy about policy making) becomes prominent. Gershuny (1978) argues for a position which takes explicitly meta-policy making and mega-policy making -- i.e., determination of the domain of the institutions involved in the policy-making and of postures, assumptions and main guidelines for specific policies -- as components of policy-making rationality.[27] This is a concept that clearly outsteps RVR.

3.2.4 Some Writers Recommend Measures Which Outstep RVR: Among measures which outstep RVR, found in the policy science literature, the following are mentioned:

(a) **Meta-policy making:** Dror stresses the need for meta-policy making as a component of an adequate ("optimal-rational") policy making process (1968). This is a policy about policy making. It is supposed to determine what should be done in policy making, how, when, and by whom, and what controls should be used. Thus, it determines required measures of personnel, structure, "rules of the game," equipment, and "policy making culture" (Dror, 1971, p. 74). The importance of meta-policy making is recognized by various authors (e.g., Krone (1980); Kickert-Gigch (1980)).

Against the claim that meta-policy making outstep RVR an alleged objection can be made. According to it RVR can be made

There is also some awareness that policy-making and implementation is done within an organizational _milieu_ and within a political _milieu_, which partly overlaps. Characteristics of these _milieu_ exert some considerable impact on policy-making and implementation. These impacts contribute to deviation from RVR, and cannot be accounted for or compensated by RVR based methods.

Bureaucratic structure and dynamics[19] influence heavily all the stages of policy-making and implementation, from the perception of the need for a policy through selection and implementation. The combined effects[20] of the bureaucratic structure and dynamics distort information collecting, distract information processing and disturb implementation. It is documented in the domestic[21] and foreign[22] policy areas. The very structure of managerial and governmental organizations which is usually divided along the so-called "functional" lines,[23] induce a kind of grandiose _divisio_ fallacy.[24] The real world is fragmentedly perceived. Each department or agency "sees" a different world. When the interdepartmental and the intradepartmental effects of bureaucratic structure and dynamics--which degrade the quality of information and advice provided by the bureaucracy, reduce its reliability, and raise uncertainty concerning its operation -- are taken into consideration by policy-makers, then the issue of endogenous uncertainties has to be confronted. If rationality is exhausted by a choice of an alternative from a set of alternatives produced by a bureaucracy characterized by those "pathologies," than is may be foolish to be "rational." This conclusion is accepted by Edwards and Sharkansky (1978) among applicable to meta-policy-making by broadening the set of acts such that the set includes meta-policy acts as well as (object level) acts. RVR-based models are supposed to be adequate when the set of acts is of such a broadened sort.

This objection is refuted because of two interconnected points. The first is that the broadened set of acts is indefinite. The second is that there is not any suitable meta-meta-level from whose viewpoint the determination of the inclusion in the broadened set can be made. The broadened set is indefinite because when a problem is given it does not constrain radical alterations to it (or to its formulation), say by changing basic relevant theories, even basic metaphysical commitments and canons of thought. Because that lack of constraints on radical alterations the broadened set of acts for any given problem, is indefinite. As indefinite set, RVR is not applicable to it. That somehow the set of meta-level options is constrained is true. But it is constrained on the basis of acquaintance with the context, not on the basis of some formally given trans-contextual rule.

Moreover, assume that the set of acts in the original problem, P, is broadened (in the manner mentioned above). Then we face a new problem, P′, which is now supposed to be decided by RVR. But then there may be meta-level considerations relevant to it. By the same line of reasoning, in order to make RVR applicable to it, P′ is now broadened to include these meta-meta-level considerations. A new problem P" emerges. P" is subject to some meta-level considerations. In order to make RVR applicable to it, it is now broadened to include them. So we face now P'", etc. It follows that the attempt to treat meta-levels problems exclusively by RVR leads to infinite regress. In other words, the commitment to RVR as the only R-concept leads to irrational-rationality for there is always, at least, one additional meta-level which cannot be accommodated by RVR-based models, and thus, because of the exclusivity of RVR, it has to be regarded as left to irrationality (as openly admitted by Popper (1962, Vol. II, pp. 230-231)). Essentially the same arguments hold for items (b), (c) and (e) below.

(b) **Institutional (Re)Design:** Institutional design is taken to be one component of meta-policy making (Dror, 1968, p. 74) and mega-policy making (Dror, 1971, p. 65-66). Shaping the institutional design of those organizations which participate in policy making predetermines, at least partly, the result of particular policy efforts. Gershuny (1978) builds on Dror's work. "Design of administrative structure" is explicitly placed as a component of his model of rational policy-making. Gershuny exemplifies the importance of institutional redesign in a comparison of two policy efforts taken on the municipal level. Hooker (1982) (1983), and Bjerring and Hooker (1980) among others, give institutional design a crucial importance in policy making both as an improvement of a part of our external cognitive system, and as a way of living. According to Hooker, the main effort of policy-making, at least in some areas like energy, should be the construction of institutions of a different design than the received one which is based around the relationship of trading commodities.

(c) **Meta-Institutions:** Beer (1975) argues that for cybernetic reasons, direct intervention within organizations of a certain structure is doomed to failure. Institutions which shape our public and private lives have that particular structure. Therefore, argues Beer, the way for effective intervention is via meta-institutions which control the known institutions meta-systemically.

(d) **Constitutive Rationality:** In a paper which is more critical and programmatic than constructive, yet insightful and provocative, Tribe (1973) argues for the necessity of a new kind of rationality concept which he terms "constructive rationality". Tribe locates the need for this concept of rationality which outsteps RVR in those decisions where the agent's ultimate ends (or basic values) are reshaped as a result of choices made by him. Tribe's argument can be encapsulated as follows: (i) Instrumental rationality methods (including policy-analytic methods) "simply cannot address the question of what one's ultimate ends and values <u>ought to be</u>" (p. 618). (ii) Some policy problems, e.g., some of those connected with the introduction of new technologies, but also many others, involve alterations of society's (or the agent's) basic (ultimate) values (ends). These alterations may accrue as impacts of those decisions taken by the agent. (iii) It follows that there are policy problems which cannot be adequately treated by instrumental methods. For when the reshaping of basic values has to be taken into consideration, instrumental methods, which cannot address questions of what values one ought to have are not adequate. (iv) A new concept of rationality, termed "constitutive rationality" is required. Constitutive rationality would make possible reasoned treatment of problems involving the establishment of ultimate ends. In particular it is supposed (or required) to be adequate in cases in which the identity of the agent changes as a result of implementing his choices.

(e) **Model Validation**: Gaas (1983) claims that the improvement of the utility of policy analysis models is a major task for the Operations Research community in the 1980's (p. 623). Validation, i.e., establishing "the agreement between the behavior of the model and the real world system being modeled," tends to be the overriding concern of the analyst (p. 609). This effort to establish that the model adequately represents the real world system under discussion, and to monitor in time this adequacy, is intended to provide insight and not numbers (p. 623). Validation inherently involves judgments made from meta-levels. For it compares "the behavior of the model and the real world system being modelled." The meta-level judgment that the appropriate meta-level has been taken and that the appropriate method of validation have been used inherently outsteps RVR, as argued extensively, albeit in a somewhat different context under item (a).

These measures outstep RVR; they cannot be accounted for, or recommended, by (a theory based on) a concept of formally calculated instrumental choice.

3.2.5 Yet, RVR is Still Presented as the R-concept for Policies: According to Majone (1980) there is a Received View on policy-making and analysis:

> "Two of its tenents are of particular importance: that policy-making can be equated with decision-making; and that the object of analysis is to produce facts and proofs rather than evidence and arguments ...
>
> The Received View on analysis ... is a conceptual compound that includes elements from operations research and management science, from microeconomics and decision theory, and a dash of social and behavioral science ...
>
> Under the Received View, ideal policy-making, rational decision-making, rational problem-solving, and policy analysis are synonymous. There is a one-one correspondence between the stages of the policy process and the phases of analysis." (pp. 162-163)

It is quite clear that RVR, the R-concept underlying microeconomics, decision theory and the technological disciplines of operations research and management science -- is the R-concept of what Majone calls "rational decision-making" which is synonymous, under the Received View on policy, to ideal policy-making.

In the words of another policy analyst:

> "Policy analysis may be defined as the choice of the best policy among a set of alternatives with the aid of reason and evidence." (MacRae, 1980, p. 74)

3.2.6 But, No Theoretization of Policies is Found: A fruitful and insightful characterization of policies either by definitions of the terms involved, or ultimately by some theoretization, is still lacking. Such a characterization can, presumably, enhance understanding of the phenomena of policies, on the one hand, and improve the results of making and implementing policies on the other. Yet the situation is different.

1) Policies perceived as choices: When RVR is taken, explicitly or implicitly, as the relevant R-concept, policies cannot be seen but as choices. Indeed, a large portion of what is said about policies in the policy science literature is just this, viz, that policies are choices, or some particular sort of choices. The relation between RVR and choices is perspicuously expressed in Simon's classic (1945, pp. 67,75):

> "Roughly speaking, rationality is concerned with the selection of preferred behavior alternatives in terms of values whereby the consequences of behavior can be evaluated."
>
> "At each moment the behaving subject, or the organization of numbers of such individuals, is confronted with a large number of alternative behaviors ... Decision, or choice, as the term is used here is the process by which one of these alternatives for each moment's behavior is selected to be carried out."

Thus, when RVR is adopted, explicitly or implicitly, policies are constrained to be grasped as choices.

"The word policy is commonly used to designate the most important choices made either in organized or in private life. (Lasswell, 1951, p. 5)

Similar statements can be multiplied easily.[28]

2) Policies as choices of a comprehensive scope: To distinguish policies from other choices, which like policies are if rational, exercises of RVR, some writers use the alleged wider scope of policies. As argued above not much else can be done, given the adoption of RVR. In the passage from Lasswell (1951) policies are distinguished by being "the most important choices." This in itself is not very informative. In Tangri and Strasberg (1980) even this quasi-characterization is eliminated and, policies are described simply as cases of applying RVR. But many writers find in the wider scope the hallmark of policies.

"Those [decisions and actions] which have the widest ramifications and the longest time perspective, and which generally require the most information and contemplation we tend to reserve the term <u>policy</u>." (Bauer, 1968, p. 2)

In this statement the wider scope of policies refers to the ramifications, time perspective and the information and contemplation required.[29]

3) Avoiding an explicit characterization of policies: When it is felt that not much can be said about policies, then a reasonable response is not to say anything at all. This attitude has two versions. To say something, but about a surrogate term or concept. The other is to skip it in silence. Thus, some writers only characterize "policy analysis."

> Policy analysis is the painstaking investigation of matters of public concern ...
>
> Policy analysis may be defined as a procedure for carefully balancing the pros and cons of making a specified change in the tasks or procedures or rules of an organization ...
>
> ... Here we are concerned more with the role of rationality than with the role of political pressure in policy making ... we focus on the moment of decision." (Mood, 1983, pp. 1-4)

The following components can be detected in this characterization. First the author writes about policy analysis, and not about policies. The focus is on the moment of decision; and a decision is taken to be a choice, a selection of a preferred alternative (Ibid., p. 6). The concern is with the role of rationality, which can be seen to consist in a version of RVR. Policy analysis is seen as about "making a specified change in the tasks or procedures or rules of an organization" "of public concern." Wider scope again.

Others speak about the sciences which contribute to the study of policies and to the education of policy scientists.

> "The underlying disciplines of the policy sciences are the management sciences (operations research, cost-effectiveness analysis, systems analysis, economics, etc.) and the behavioral sciences (political science, sociology, social psychology, organization theory, behavioral theory of the firm, psychology of judgment etc.). The management sciences can be viewed as sciences of normative knowledge." (Lewin and Shakun, 1976, p. 4)

The normativity of those management sciences mentioned by Lewin and Shakun is the normativity of RVR. Similar views are numerous. Quade

(1975, p. vii) is an example.

Some write about "policy decisions." E.g.,

> "A public policy decision is a decision made for itself (the election of a President, for instance) or for society by its elected representatives -- decisions taken by individuals or groups that have material effects on individuals other than those involved in making the decision." (Quade, 1975, p. 3)

Dror (1968) writes about the public policy-making process. He finds the process very complex and dynamic. In it

> "major guidelines for action directed at the future mainly by governmental origins" (<u>Ibid</u>., p. 12)

are decided. The closest that Dror comes to characterize policies is

> "These guidelines (policies) formally aim at achieving what is in the public interest by the best possible means." (<u>Ibid</u>., p. 12)

So policies are seen as RVR-based choices of guidelines for action directed at the future. Because these choices are made in an aggregative form, Dror (<u>Ibid</u>., p. 13) thinks that they "differ in important respects from discrete decisions that most decision-theory literature deals with." Also, "policies are" often partly formed and partly "executed" by the same sub-decisions of the two flows of decision making, one from top down and the other from down up (p. 14).

The detailed model of Dror focuses on the stage of meta-policy making. The need to throw more light on the nature of policies does not arise. In his other publications, Dror makes efforts to avoid giving a characterization of policies.

Reviewing this situation a leading political scientist writes:

> "I have gone through some 50 pieces of research on policy questions in the last few years and every instance is marked by the absence of any attempt to define the term ['policy'] ... The meandering and haze occur because we have yet to clearly conceptualize policy and planning ... they are often made synonymous with decision, goal and outcome." (Landau, 1973, p. 537)

4) Present alternative characterization of policies: Notwithstanding the situation described above, some writers attempt to present alternative characterization of policies. A closer look at each of these proposals reveals that if it is successful it involves, or requires mainly implicitly, an alternative R-concept to RVR. Among the works that exemplify this approach the following works can be mentioned. Although they differ in content and style each is an attempt which deviates from RVR in one important aspect or another; Majone (1980) (1978); Wildavsky (1979); Meehan (1985); Hooker (1982) (1983); Vickers (1965) (1968). We turn to a brief discussion of some of these. We focus on those aspects which involve or require an alternative to RVR. The warrantability or correctness of these characterizations is not the issue under discussion. To substantiate the claim made above it is sufficient to show that if the particular author is successful in his attempt then an alternative R-concept is involved or required, if only implicitly.

Vickers, in a long series of publications rejects the model of goal-seeking as a model for human motivation (1965, 1973a), action

(1965, 1968), decision-making (1965, 1968) and policy making (1965, 1968, 1970; 1973), in the individual and institutional areas. According to this model humans are motivated by known goals, and act and should act as for the attainment of such goals. Vickers substitutes for it a model of "attaining or maintaining desired relationships through time or ... changing eluding undesired ones" (Checkland, 1985, p. 761).[30] Because of this substitution, RVR is not applicable for Vickers' model, unless the model of "maintaining desired relationships through time" can be mapped onto the goal-seeking model. But if that mapping holds then Vickers is unsuccessful in his attempt to provide a new characterization of policy making and policies. By this it is clear that if Vickers is successful, then his model has to be backed by an R-concept which is different from RVR. Notwithstanding this conclusion, it can be added that indeed Vickers' model cannot be mapped onto the goal-seeking model (which is an RVR-based mode). For Vickers takes it as essential ingredient of the process of governance (as he calls it) that the norms and standards which direct the process are self-set and not externally given (Checkland, 1985, pp. 761-2; Vickers, 1965, pp. 13-35; Vickers, 1970, pp. 197-203; Vickers, 1973b).

The argument with respect to Hooker's models of policies and policy making can be simplified by noting that Hooker builds upon Vickers' model. But Hooker (1980, 1982, 1983) provides a basis for an argument which is specific to his approach. Institutional designs and procedures have a pivotal role in Hooker's model. Only when they are set within some institutional and cultural context, normative statements express contents of public policies (1983). Moreover, institutions are seen as crucial for our science and indeed for the very manifestation of reason within human affairs in general (1982) and in public policy, in particular (1983). Among the requirements that a desirable institutional design should satisfy is the one that "policy making processes should be learning processes for the whole community" (1983). The community has to "learn about its bio-physical and social structure and functioning" (1983). But, as discussed above (3.1.4) concerning endogenous uncertainties, Suppes (1966, 1980) has shown that in cases of uncertainty, Bayesian theory, which is the relevant RVR-based model, cannot account for the emergence of (relatively) novel concepts. These concepts may be required in cases in which some public policy intervention is called for, like in cases of discontinuous change. When the required learning includes (relatively) novel concepts another R-concept is called for backing the model, instead of RVR. Moreover, Hooker argues that the required learning within the institutional setting "involves tolerance of failure ..."

> "that is learning requires 'safe-fail' (safe-for-failure) or resilient systems, not 'fail safe' (safe-from-failure) systems" (1983).

This is incompatible with RVR which can suggest only fail-safe systems, based -- for the case of uncertainty -- on Bayesian theory, in which errors should be eliminated, and failure or error has no positive value. (More on this theme in (5.1.2.3)). Thus, Hooker's model needs to be backed by an alternative R-concept to RVR.[31]

Wildavsky (1979) provides some characteristics of policies and policy making. These are more scattered and fragmented than systematic and unified. Yet Wildavsky is aware that his views of policies require some departure from the standard concept of rationality (i.e., from RVR). This departure from RVR presented along diverging lines. On the one hand Wildavsky accepts the criticism of the social-psychologist Weick that rationality is nothing but rationalization. He cites Weick to the effect that "[r]ationality ... is a process of justification in which past deeds are made to appear sensible ...". In Wildavsky's own words: "Rationality tries by intention and is saved by rationalization" (p. 136). On the other hand, he says later in his book that,

> "I have written this book to show that policy analysis is about learning what to like; analysis is less about the realization of preferences than about their transformation. *This is my quarrel with the present paradigm of rationality*: it accepts as immutable the very order of preferences it is our purpose to change ..." (p. 404; italics added).

The two lines of retrospective rationalization (p. 136) and prospective transformation of preferences are divergent. Yet, each of them deviates from RVR, which is prospectively oriented for the realization of given preferences.

3.2.7 **"A Conservative Ideology and Progressive Practice"**: Classical, post-Galilean science, claims Feyerabend (1970), is characterized by the sharp contrast between its practice and its ideology. The practice of post-Galilean science, according to Feyerabend, is critical, any part of it can be revised, no matter how close it is to experience. Its ideology is dogmatic: it emphasizes that the hypothetical parts of science will be changed into either trustworthy theories or else will be discarded. "[A]ll theories rest on one and the same stable foundation, experience" (1970, p. 150). As a result of these two attitudes science is engaged in an activity that prevents the realization of a stable foundation for itself, in contrast to the basic assumption that there is such a foundation.

> "I use the term "classical empiricism" to describe this fascinating, tortuous, schizophrenic combination of a conservative ideology and a progressive practice." (Feyerabend, 1970, p. 151)

What is peculiar to post-Galilean science, says Feyerabend, is "the manner in which this abyss between ideology and practice is bridged". My claim is that the situation in the policy sciences, as described above, is similar to Feyerabend's description of classical science. The two cases differ with regard to the treatment of the gap between practice and ideology. First, the similarity: Several examples were given above which show that there are attempts to suggest new approaches which outstep RVR. These approaches are both on the abstract conceptual level and also in practical examples of case studies.[32] Thus, the practice of policy analysis making and implementation is progressive. Nevertheless, the declared ideology is that RVR is the R-concept of policy theories. This ideology is dogmatic. It remains unchanged in the face of growing awareness that

RVR is inadequate for the treatment of policies. But the situation in the policy sciences differs from that of classical science in an important factor. The gap between the practice and the ideology in the policy science is basically accepted. Quade (1975) provides an example. Quade is fully aware that policy problems differ from military and industrial problems by their more messy and ill-defined nature. Because of their being ill-defined, the methods of operations research and systems analysis are not applicable to them. Policy problems require the use of judgment and intuition, says Quade (p. 21). They encompass not only decomposition into parts but also "the design and invention of new possibilities" (p. 20). To solve a social problem an analytical solution is not enough, says Quade (1975, p. 25), but "one must find a way to induce social change to persuade many people to behave differently" (p. 8). Nevertheless in the same book Quade writes:

> "If one were to set out to train policy analysts, one would see that they were taught microeconomics, decision theory, organization theory, linear programming, probability and statistics and so forth." (Quade, 1975, p. vii)

It is worth noting that the common denominator of these various intellectual areas is their R-concept; some version or another of RVR (under certainty, risk or uncertainty conditions). It is important to teach these areas not only as a depositary of knowledge and models, but first of all, because the required normative power is lent to policy theories by their use of these theories, and thus, indirectly, the use of their R-concept, namely RVR. This is put forcefully in the passages quoted above from Majone (3.2.5) and from Lewin and Shakun (3.2.6).

Thus it is recognized that the present situation in the policy sciences can be rightly characterized as "a conservative ideology and a progressive practice", but with the gap as yet unbridged.

3.3 This Situation -- An Untreated Abyss Between a Conservative Ideology of Normality and a Progressive Practice of Applications -- Is an Inherent Feature of RVR

If there is such an abyss, as argued above, why is it left untreated? The crucial move in the treatment of the similar abyss in classical science, according to Feyerabend (1970), is the re-identification of experience -- which is supposed to be the stable foundation of science and arbiter of hypotheses -- with "that part of a newly conceived hypothesis that can most readily be illustrated by simple and eye-catching procedures" (p. 150). In other words, the element which is proclaimed stable by the dogmatic ideology is reidentified with new elements put forward by the progressive practice. This move is possible because it is not prohibited by any second-order theory which determines what is to count as experience. This leaves some freedom to reidentify experience with those elements of a new hypothesis which make the interaction of the hypothesis and the world -- by way of examples and illustration -- smooth and stable.

In the case of theories of rationality, such a reidentification of the elements which carry the conservative ideology with new elements produced by the progressive practice, is not unproblematic. What may prevent such an identification is the normative-epistemological (meta-theoretic normative) function of an R-concept.[33] This function determines what can be counted as an R-concept, because it determines the concern, the shape, and the main parameters of the theory of rationality. Some theories of rationality may be quite restrictive and allow for only one first-order theory of rationality or for only those R-concepts which are compatible with their second-order normative (i.e., epistemological) claims.

When RVR is adopted as the R-concept for policy theories, the second-order function of RVR allows for only one theory, one R-concept, to be accepted as a first-order theory of rationality. This theory is simply RVR itself. For RVR specifies its claims in terms which are rather basic and do not leave latitude for a variety of interpretations or identifications. RVR claims that rationality is about choices, that choices are instrumental, that ends are given and that the choice of a means is a choice of a best means from a given set of means for the attainment of those ends, that the choice is done formally, and that the principle of analysis holds. In its second-order normative role RVR demands that any theory should be like this in order to count as a theory of rationality. If some part of it is (first order) identified with an element of a new practice, say with the use of insight and judgment, then this reidentified part clashes with some second-order strictures of RVR which demand that for being a theory of rationality the theory should be of some specified character. Thus, the use of insight and judgment is ruled out by the formal component of RVR. Hitch's explicit claim (1961) that ends should not be treated as given in policy discussions -- a claim which is based on a case of practice which is described in the next chapter -- is simply overruled as irreconcilable with the second-order strictures of RVR. Of course, this is not to say that experience with recalcitrant cases could never lead one to revise the RVR second-order strictures; it is only to say that while even the difficult task is not accomplished these strictures will block critical examination of RVR at the operating first order level.

RVR has simultaneous roles on three levels: (i) as embodied in specific decision theories; (ii) in the theory of rationality with its descriptive and prescriptive components, which determine, respectively, how things are done rationally and how things should be done rationally; and (iii) in a meta-theory of rationality with its ontological and epistemological components, which determine, respectively, what is it which can be regarded as rational and with what a rationality theory should be dealing. Because of this structure of roles no argument against some particular decision models and decision theories can lead to a change in the rationality theory without a (prior or simultaneous) change in the meta-rationality theory. As it happens, the meta-rationality resists changes more than the level of decision theories. Thus, while decision theories changed as a result of criticism, the changes were within the RVR variety. On the level of rationality theory RVR was not substituted as a result of repeated failures of application. Once RVR is adopted (at all these levels) difficulties in application tends to be seen as due only to poor implementation.

Because RVR is stated in specific and strict claims, couched in basic enough terms, it allows for only a narrow range of interpretation. The result is that virtually only one first-order theory of rationality is compatible with RVR as a second-order theory. Granted that every R-concept has also a second-order function, once RVR is adopted, re-identifications of those elements which carry the conservative ideology (concerning rationality) with new elements produced by the progressive practice (of dealing with real-world policy issues) are prohibited. The second order function of RVR exposes them as (RVR) irrational. The result is that the abyss between the progressive practice and the conservative ideology is not bridged.

This inherent abyss between the conservative ideology and the progressive practice, once RVR is adopted, has several important consequences:

(i) Confrontations of RVR with the practice of policies does not produce criticisms of RVR on the level of rationality theory. Any such clash can only be regarded as a deviation (of human performance) from rationality. If anything is to be criticised at all, then it is the practice. Such a continued situation, where the theory tends to be immune and the practice is condemnable, can only breed anti-rational attitudes and irrational sentiments.

(ii) Given that the practice is progressive and that the theory (i.e. RVR) is conservative, no theoretization of policies is possible. For a theory like this has to rationalize the practice of policy-making and implementation, but this cannot be done with RVR, which condemns as irrational any deviation from itself (like those found in practice) and is not illuminating by itself.

3.4 RVR Cannot be Regarded as Adequate for Policy Theories

Because of Reasons Concerned with Nature of Policies. The conclusion which can be drawn from the discussion in this chapter--the philosophical abstract argument, the messy situation in the policy sciences, and the analysis of the roots of this situation in the nature of RVR -- is that RVR cannot be regarded as in particular adequate for policy theories because of reasons concerned specifically with the nature of either policies or policy theories.

Combined with the conclusion of Chapter 2, that the RVR ideal, CFR, is impossible, it can be said that both defense 1 and defense 2 of the thesis that RVR is adequate for policy theories (Thesis 1) (1.5) are rejected. In order to look for suitable R-concept for policy theories we turn to Chapter 4 to a successful case of a policy study.

NOTES

(1) Popper's contention (1962, Vol. II, pp. 230-1) that ultimately his choice of the "rationalistic attitude" is an act of faith, is an example for this point.

(2) This second-order normative role of an R-concept should be distinguished form the "ought" in the "is-ought" problem. The is-ought is a first-order distinction. The "ought" and the "is" refer to the same kind of entities, be it states of affairs, or whatever the accepted ontology determines. The second-order normative function refers to first order normative concepts and asks about the rational grounds for adopting any one of them. Thus, even when the is/ought distinction is taken as a hard dichotomy, it can be asked whether repeated failures of doing what is ought to be done can indicate that a first order normativity of some "ought" has to be modified, revised or completely substituted. (See also section 1.2.5 above).

(3) See for example Tofler (1970); Hooker (1983).

(4) Non deterministic processes can be divided to those which can and those which cannot be adequately captured by probablistic models, see Klein (1977).

(5) Suppes (1985) discusses unstable processes.

(6) Simon's (1945) started a school of research which puts a heavy weight on the role of the limited (or bounded) cognitive capacities of the decision makers. See also Simon (1977); Dror (1983).

(7) See George (1980) for a comparative discussion of different patterns of relationships between top decision makers and consulting units.

(8) The headings below are taken from Ingram and Mann (1980).

(9) No one who has some acquaintance with policy making claims e.g., that alternatives are given. What appears in textbooks and other publications as the concept of rationality, or the rationality model, is some sort of a scheme like the one below in which several steps are detailed which, together, express the ideas of RVR in the context of policy making.

(10) Thus, the purpose of this subsection is not to argue for or against the correctness of the views reported below, but only to show that, as a component of the whole mixed picture of the

situation in the policy sciences, there is some awareness among policy scientists that attempts to apply RVR to policy issues do not succeed.

(11) Similar schemes are mentioned or proposed by, e.g., Tribe (1973, p. 621); Edward and Sharkansky, (1978); Carley (1980, p. 11); Hogwood and Gunn (1984, p. 45); Mood (1983, p. 6) among many others.

(12) E.g. Dror (1964); Etzioni (1968). In my view the main flaw with Incrementalism is its neglect of the crucial point which is the overall relation between the capacities of the system to direct and control its affairs and the complexities of the world embedding it. Even if each one of the policy efforts is made by the Incrementalistic way, the overall burden on those capacities may be over exhausting. In such a case the system is bound to suffer failures. On the other hand Lindenblom neglects the ways to amplify that overall capacity which may include better theories and better organizational designs and procedures.

(13) Edwards and Sharkansky (1978, p. 99) brings the case of the policy effort taken following the urban black riots in 1966. "President Johnson appointed a special commission to advise him about the underlying problem." It was not clear whether it was urban unemployment, inadequate education, unresponsive elites or some combination of these. When the commission pointed at "white racism" as a major cause, the President refused to accept this conclusion. For philosophers it is not surprising that perception, especially of complex social phenomena is not passive; that perception is "theory taken." Again the point is to indicate awareness among policy scientists of the inadequacy of the standard.

(14) Edwards and Sharkansky (1978). Of special importance on this point are Hitch (1960) and (1953).

(15) Edwards and Sharkansky (1978, pp. 118-119); Quade (1975, pp. 116-123).

(16) On the limitations of prediction, especially for policy efforts. See e.g., Quade (1975, pp. 239-242); Brewer and de Leon (1983).

(17) George (1980); Quade (1975).

(18) On the choice of criteria see Hitch and McKean (1961); Quade (1975, pp. 91-101).

(19) Wilensky (1967) and Downs (1967) describe various ways by which bureaucracy influences communication and information and try to provide defences against them.

(20) George (1980).

(21) E.g., Edwards and Sharkansky (1978).

(22) E.g., George (1980); Edwards and Sharkansky (1978).

(23) E.g., Galbraith (1977); Ganon (1979); Hax and Majluf (1981).

(24) Beer (1961).

(25) Sen (1977a) argues that RVR-type theories -- like micro-economics -- cannot account for a phenomena which he argues is basic and reasonable, i.e., taking "rational fools." Manheim (1979) argues on the basis of the limitation of individual rationality on the one hand, the reduction of decision to measurement of costs and benefits on the other, that rationality based methods are inadequate for transportation planning.

(26) Dror, (1968) (1983) (1971).

(27) See 3.2.4 below.

(28) E.g., Rothwell (1951, p. ix) "The application of policy is a calculated choice ...", Bauer (1968, pp. 1-2); Nagel (1977, p. 9); Tangri and Strasberg (1980); Nagel (1982), p. xiii).

(29) Similar statements are given by MacRae and Wilde (1979, p. 3).

(30) Checkland (1985) quotes a letter sent to him by Vickers in 1974. In this letter Vickers present a concise statement of the main points he had contributed "to the general debate."

(31) Indeed Hooker (1982) includes a model of rationality radically different from RVR. This model can back Hooker's conception of policies.

(32) Gershuny (1978) which is cited above. See also next chapter. See also the cases in Wildavsky (1979) and in Meltsner (1976).

(33) See section 1.3 above, for the subsequent discussion.

Chapter 4: The Case of the SAC Basing Study: A Successful Policy Analysis

> "Experience in solving problems and experience in watching other people solving problems must be the basis on which heuristic is built." (G. Polya, 1957, p. 130)

> "We cannot speak here [while accounting for the explanation of scientific discovery] of deducibility in the strict logical sense; and certainly not of an algorithm of discovery. We can speak here instead of a heuristic account, i.e., one which guides us in understanding the creative process by reconstructing the strategies, the methodological rules, the 'rules of the art,' the modes of judgment, that were involved in a given process of discovery or invention in science. It is this kind of comprehending how a scientist may have proceeded in thought, that falls within the category of scientific judgment." (M. W. Wartofsky, 1980, pp. 8-9)

If RVR is found to be inadequate to serve as an R-concept for policy theories, what kind of R-concept may be adequate? An attempt to gain some insight into this question is made in this chapter by studying a successful case of policy analysis in order to extract its R-concept.

The selection of a case for this purpose is done by an appeal to some intuitive criteria for adequacy, which are supposed to be independent of the range of theories under discussion. Some methodological issues involved in the selection of a study for this purpose are discussed in 4.1. The case selected for this study was undertaken in the early 1950's in the RAND Corporation for the U.S. Air Force. It is known as the SAC (Strategic Air Command) Basing Study, or SACBS for short.[1] This policy analysis, which was initiated as a case of military logistic and ended by moulding national defense policy for a long period, is described and studied, from the viewpoint of its (implicit) method and rationality, in 4.2. Following an overview of the case in 4.2.1 the distinguishing characteristics of the case which were responsible for its remarkable success, are scrutinized more carefully in 4.2.2-4.2.7. Among these characteristics are: (i) a search for the right question to ask, the right problem to research, followed by substituting the right problem instead of the original one; (ii) objectives were not taken as given, but were scrutinized, and virtually self-set; (iii) the emergence of novel concepts and a new vision; (iv) the approach taken was empirical, iterative, dialectical, and reflective; (v) organizational (institutional) factors were among those which contributed to the success of the study; (vi) alternatives were not given, but designed during the SACBS for its purpose; (vii) relaxation of unjustified self-imposed constraints, was an important ingredient of the method; (viii) the study looked for the systemic nature of the problem; (ix) the criterion used was not of the maximization or minimization variety, but that of robustness, i.e., achieving a satisfying level of performance against some range of contingencies judged as relevant; (x) appropriateness of a model was considered to depend not only on the world (the situation) but also on the question asked.

In 4.3 a first sketch of the incipient R-concept, used implicitly is the SACBS, is made. It is argued that RVR cannot capture this rationality. On the surface the differences are striking. But an argument given shows that the gap between RVR and the rationality of SACBS cannot be bridged because of logical reasons. An attempt to use RVR for this purpose necessarily ends either with an absurdity or with an admission that some parts of the method of RVR, which is regarded as adequate for its domain, are left outside the reach of RVR. This argument builds on a triple distinction introduced here between an R-concept, which justifies a method, which systematize a domain, which is rationalized by that R-concept.

4.1 Methodological Preliminaries

Assessing the adequacy of a proposed R-concept, as an alternative to RVR in the context of policy theories, is analogous to the issue of assessing normative methodologies in the philosophy of science. Normative methodologies purport to provide an account of the norms which "ought to govern scientific theorizing" (Wykstra, 1980, p. 212). Einstein's maxim -- to attend to what scientists do rather then what they say they do -- is applied to the work of methodologists in order to arrive at an answer to the question how should normative methodologies be assessed. A dominant approach to this issue is the so-called "intuitionist strategy." The first stage of this strategy picks some "pre-analytic intuitions" which may lead one to suppose that if rationality is to be found anywhere, it is to be found in some designated set of historical episodes. The second stage asks concerning a proposed methodological theory whether those episodes were rational in the light of that theory. If the episodes which on pre-analytic intuitions are regarded as rational are found rational by the examinated methodology, its norms are found to be descriptively adequate, and, by this, capable of having normative force (Laudan, 1977, pp. 158-163). Wykstra adds that these norms should be indicated "by showing that their employment optimally promotes the realization of scientific aims or values" (1980, p. 213).

Turning to the search for an alternative to RVR as an R-concept for policy theories (because RVR is found inadequate for those theories), a similar approach can be taken. A proposed alternative to RVR should, at least, recognize as rational those cases of policy analysis and making (if there are any) which can justifiably be regarded as exemplifying a relevant rationality. If there are such cases of policy analysis and making, then their embodied norms of rationality, when elucidated and consolidated, can serve as a benchmark for the construction of such an alternative. Later these norms of rationality should be in a 'reflective equilibrium' with the emerging R-concept; they may be criticized by it. The emerging R-concept, and via it these norms should relate to other visible historical episodes of rationality, when such episodes are identified.[2] The crucial point is, of course, the justification of the selection of any particular case as an example of a relevant R-concept in application. The required justification is tricky because it has to be done prior to, and as a preparatory step for, the construction of an explicit R-concept for policy theories.

An adequate theory-based characterization of the "successfulness" of a case of policy analysis cannot be given independently of an R-concept for policy theories. Thus, the situation calls for an "external" characterization of a successful case of policy analysis. Such a characterization can be given by listing as criteria of successfulness some external features which sometimes accompany the results of policy analyses. Internal factors, such as the content of the case, are in intimate relations with the particular R-concept. To overpass this tangled web between the search for R-concept and the content of the case only external factors are admitted as criteria for successfulness of a case.

Intuitive criteria for the successfulness of a policy analysis may include the following:

(i) The case should be considered as successful by both parties, the agent (sponsor) and the analyst (advisor);

(ii) The recommendations of the analysis should have been implemented by the agent;

(iii) The implementation of the recommendations should have increased the agents effectiveness (where this effectiveness is assessed by some relevant and agreed upon, expected and realized results -- in case these can be found);

(iv) The implementation of the recommendation should have been recognized as the adoption of a new policy;

(v) These evaluations of the case should have remained intact over a considerable period of time.

It has to be noted that this list if but a first pass. Should it be necessary, if no suitable case can be found which meet these criteria, then another trial at formulating criteria of this sort will be called for.

There is a dilemma involved in judging a case of policy analysis as successful. There is more than a grain of truth in the claim that "successfulness" has an inherently "global" character (Churchman, 1968). What is seen as successful from the viewpoint of a component may be seen as failure form the viewpoint of the system and vice versa. Patients still die, sometimes, following successful operations. A collective's appreciations may differ from those of its individual members. A satisfying course of action may lead, in a few steps, to a dead-end. Every system can be seen as embodied in a more comprehensive one. Thus, we are driven to use wider and more comprehensive viewpoints, over the organizational, societal, cultural, spatial and time dimensions, in order to justifiably attribute successfulness. Ultimately, argues Churchman (1968), only by knowing the whole system -- and this includes knowledge of many counterfactuals concerning courses of action which have not been chosen and implemented -- it is possible to judge improvement in a subsystem; only from the viewpoint of the whole system can the success, or the failure of a system be judged.

So, one horn of the dilemma is that because of the inherently global features of successfulness, the viewpoint of the "whole system" seems inevitable. The other horn emerges because the use of the whole system's viewpoint is simply unfeasible. But when it is given up a danger arises, of drifting into subjectivism, relativism, and arbitrariness. Indeed, if the whole system's viewpoint is needed, anything less commits these vices. The five criteria above give a way out of this dilemma between objective globalness and arbitrary locality. They point to an intuitive, local and fallible, though not narrow and arbitrary, judgment of success regarding cases of policy analysis.

A case which, over a considerable period of time, continues to be regarded by the parties involved, as well as by contemporary researchers (e.g., Williams, 1975; Friedberg, 1982), as an adoption of a (new) policy which increased effectiveness when implemented, seems to contain a sufficient measure of intrasubjectivity, if not objectivity, to warrant being taken, between the horns of the dilemma, as an example of a successful policy analysis. Such a case can, presumably, shed some light on the issue of the relevant rationality for policy theories.

In Laudan (1986) five difficulties of intuitionistic meta-methodologies (for science) are specified. Each one of them is overcome in the selection of SACBS as an example of a successfully applied case of policy analysis. The crucial difference is that the determination of successful scientific episodes and the determination of the proper methodology for science are mutually dependent, as argued by Laudan. On the other hand, the designation of SACBS as a successful case of policy analysis is done by an appeal to the five external criteria mentioned above. These criteria are independent of either RVR or the method of SACBS. By this Laudan's difficulties are answered one by one.[3] Thus, (i) it is not because of some linguistic intuition, within some community of speakers, that SACBS is regarded as successful. Rather, it is on the basis of reasoned evaluation, regarding all the interested parties, which stood the test of time, that SACBS is regarded successful. (ii) The designation of SACBS as embodying a method which led to success, does not deny a significant critical role of the methodology which can be extracted from it, with respect to the case itself. Once that R-concept which is behind SACBS is articulated (as is done in Chapter 5), it does not depend on SACBS for its validation. If it happens to be necessary, it can be used to criticize the case itself, or some parts of it. (iii) Intuitive judgments about the relative merits of SACBS do not differ much. On the contrary, SACBS seems to be distinct for the wide consensus on its being successful (as is discussed below 4.2.1). (iv) The criteria for the successfulness of SACBS are relatively independent from methods for conducting the case. They refer to impacts of the results of the case and not to the way the case is done. By this the apparent circularity found concerning science -- i.e., that the determinations of what count as the scientific elite and what count as good science are mutually dependent -- is avoided in the applied case of SACBS. (v) Also, it is not necessary to discuss many successful cases. The single case of SACBS is sufficient for the dialectical approach taken here. It enables one to articulate an alternative R-concept whose fertility for policy theories can be assessed independently of the way it was constructed. By this all of Laudan's (1986) difficulties are answered.

4.2 From Logistics to Policy: The Case of the SAC-Basing Study

Criterion (v) above, which requires that the case selected should have a record, stretching over a considerable period of time, of being evaluated as an effective case which has been declared as a policy, directs the search for such a case to those which took place some considerable time ago. A case like this is the one known as the Strategic Air Command (SAC) Basing Study. The analytical phase of the case took place in the years 1951-53 in the RAND Corporation. The implementation of its recommendations took several years. Some of its recommendations were declared an official policy in the 1960's. This policy has not been changed since.

The RAND Corporation was established in 1948 as a private non-profit corporation with special ties to the U.S. Air Force. Its purpose has been:

> "To further and promote scientific, educational, and charitable purposes, all for the public welfare and security of the United States of America." (The RAND Corporation, 1963)

These words, taken from the Articles of Incorporation, were translated into diverse pure and applied researches, especially in areas related to national defense. Among theoretical work done in the early days of RAND, and which is discussed extensively in Chapter 2 above, is Arrow's Impossibility Theorem. The RAND Corporation, which is located in Santa Monica, California, has enjoyed organizational and intellectual independence, yet it has had a significant effect on the U.S. Air Force (and on other governmental agencies) (Smith, 1966).

Until the time of the SAC basing study the defense oriented research done at RAND dealt with tactical, technical and logistic problems. With this study RAND began research on strategic and policy issues (Smith, 1966, pp. 103-104).

As is discussed later in this chapter, the kind of relationships between RAND and the U.S. Air Force were crucial for the success of the study. First, there is the intellectual independence of the research which in this case was exercised to the extreme, in a sense which will be evident later. Secondly, without the easy approach to the highest ranks in the Air Force the study wouldn't have become as influential and effective as it was.

Following an overview of the case, the main differences from RVR in the conduct of the case are discussed specifically. The overall picture which emerges is of an R-concept which is decisively distinct from RVR.

Can the incipient R-concept be rejected because the narration of the case is done intentionally in such a way as to bring forth this concept? Are the selection and the narration of the case colored by a previously held R-concept? Laudan (1977, pp. 164-167) discusses a similar issue which occurs in the philosophy of science. The question he asks concerns narrations by historians of science. Laudan claims that:

> "it is inevitable that any historian's account of science is going to be colored by his views about how science works." (p. 165)

In order to overcome invidious effects of this "coloring" the motivating philosophy of science should be explicit and used critically. In addition, the historian is obliged according to Laudan "to see to it that he is utilizing the best available set of norms" (p. 165). This can be secured by using that model of rationality that does "the greatest justice to our [pre-analytic] intuitions about the [history of science]" (p. 165).

In our case of policy analysis and implementation, three kinds of defense are used against falling into the trap of self-justifying subjectivism. (i) The five criteria listed above refer to "external" features of the results of the selected case, and not to "internal" factors; (ii) The received concept of rationality, RVR, has been independently shown to be inadequate for policy theories. The selected case is presented by highlighting differences with RVR which are found in a policy analysis which continues to be regarded as a successful one; (iii) The emerging R-concept which can be detected in this case is further developed and articulated in Chapter 5. It is shown there to be capable to synthesize and integrate some traits of rationality into a new coherent whole. The emerging concept not only accounts for the "pre-analytic intuitions," but also paves the way for a construction of a theory of policies. Once this concept is articulated it has 'a life of its own'; it does not depend of the particularities of the case for its validation. Moreover, it can criticize the case and relate to any other case of policy making or analysis, criticize it and be criticized by it. The case is, thus, only a scaffolding for the R-concept.

4.2.1 Overview of the SAC-Basing Study: Background: In the spring of 1951 the U.S. Air Force addressed a request to RAND for a study of the selection of overseas air bases. The request was issued after the U.S. Congress had authorized some 3.5 billion dollars for air-base construction, for the fiscal year 1952. About half of this sum was allocated for overseas base construction. It seemed that even larger sums for air base construction were planned to be appropriated in the next several years. The U.S. Air Force requested from RAND advice on:

> "the most effective way for acquiring, constructing and using air base facilities in foreign countri :. The criterion then in use for guiding decision on basing questions was a very crude one having to do principally with minimum cost for given facilities." (Smith, 1966, pp. 199-200).

The work begins -- The problem as formulated by the U.S. Air Force seemed at first to be mainly a routine exercise of logistics. No one at RAND's Economic Division, to which the request was referred, was eager to work on it. Wohlstetter agreed to consider accepting the requested study. After about a week or two he agreed to take it because it seemed to him then, contrary to his first response, that maybe there were potentially some major problems raised by the study.

A search for the right problem -- Wohlstetter spent several months, beginning in May 1951, trying to formulate what exactly was the problem. He did not accept the problem as formulated by the sponsor (U.S. Air Force), but looked for some underlying deep problem. To do this he studied extensively the Air Force procedures and current basing policies. Finally he formulated his problem to be:

> "Where and how to base the strategic Air Force and how to operate this force in conjunction with the base system chosen" (Quade, 1964a, p. 26)

Approach and Methodology -- The search for the "right question" exemplifies the approach and the methodology taken with regard to some of the major issues in the process of analysis undertaken by Wohlstetter and the team which he gradually assembled. The fundamental epistemic difficulty was that neither the problem nor the methods for treating it were known at the beginning of the process.[4] The means by which they could be found out was the analytic effort itself.[5] The process unfolded as follows: (i) Gain familiarity with the U.S. procedures and air base policies. (ii) Take as the only givens the major mission of SAC, which was to carry out bombing raids on the enemy's territory (U.S.S.R.) in case deterrence fails and war breaks out, and the existing situation of the SAC. (iii) Investigate which factors are significant in carrying out this mission and the interrelations among these factors. This amounts to investigating the systemic nature of the problem and the alternative systems which should be taken into consideration. (iv) Study various objectives, criteria for measuring the attainment of these objectives, and trade-offs among the objectives and between objectives and resources. (v) Gain thereby new insights and acquire a novel concept which led to new questions and continued research. Finally, that novel concept became the fulcrum for the study's recommendation and a basis for a new national security policy. (vi) Use iterative, reflective, and dialectical moves. Sensitivity analyses were undertaken regarding various assumptions that had previously been incorporated into the study, resulting in the rejection of some of them. (vii) Communicate the emerging recommendations to Air Force officials, which led to further investigations to answer questions raised by those officials. This increased the value of the study for the sponsor and its chances of being adopted in creed and in deed.

In more technical terms, the study looked for gross differences in relative costs and effectiveness of the main sorts of alternatives which seemed conceivable for carrying out the assumed major mission of SAC. The effort was directed at determining which of the alternatives has a clear relative advantage, and not at a quantification of that advantage. Four alternatives were considered:

> "1. bombers based on advanced overseas operating bases in wartime,
>
> 2. bombers based on intermediate overseas operating bases in wartime,
>
> 3. U.S.-based bombers operating intercontinentally with the aid of air refueling, and
>
> 4. U.S.-based bombers operating intercontinentally with the help of ground-refueling at overseas staging areas." (Quade, 1964a, p. 28)

The recommendations concerning the basing issue were supposed to be given within a framework which weighs the costs against the effectiveness of carrying out the major mission. Effectiveness was to be expressed in terms of target-kill; costs were to be expressed in dollar terms. Two kinds of costs were distinguished; locality costs which are inherent in a special site (such as construction, supply, operations and defense costs which depend on local factors like the weather, terrain, availability of construction materials and construction industries, existing base facilities, transportation terminals, existing defenses) and location costs. The location costs can be expressed as functions of four critical distances "from the proposed bases to

(1) the target

(2) the favorable entry points into enemy defenses,

(3) the source of base supply, and,

(4) the points from which the enemy could attack these bases" (Quade. 1964a, p. 28)

The location costs involve a dilemma. On the one hand some costs, like those involved in extending the range of the bombers suggest locating the bases closer to the target. On the other hand, some considerations, like logistics and base vulnerability argue for pulling the bases back to extreme distances. The study proceeded by analyzing the costs and effectiveness of each alternative as functions of the location costs. Locality costs and considerations relating to the specifics of the targets were added later.

Uncertainties pervaded all aspects of research. Some uncertainties were treated by fixing some value of the relevant parameter(s), and, where appropriate, taking sensitivity analyses at a later stage. The sensitivity analyses were directed to discover insensitivity of the critical parameters to wide ranges of the economic, technological, military and political uncertainties. Similar analyses were taken to assess the relative capacity of each alternative to perform well enough -- in terms of carrying out the major missions -- under some specified and wide range of circumstances.

A preliminary review -- The preliminary investigation lasted about half a year. By the late fall of 1951 a preliminary review was prepared. An issue which until then was left to take care of itself, namely the vulnerability of the bomber force, moved to the forefront. With regard to the locality costs, the RAND team found that the regulations called for concentration of facilities in order to minimize costs. But such a system was found to be highly vulnerable to enemy nuclear attack. Wohlstetter suggested that "dispersing facilities on bases would be preferable" (Smith, 1966, p. 206). This issue had an even more important influence on location costs. It was indicated by preliminary analysis that the fourth alternative system, viz, U.S. operating bases with overseas ground refueling, is the preferred system. The draft memorandum "contained many gaps and was inconclusive at points" (Smith, 1966, p. 206), nevertheless, it overcame the skepticism and opposition which it had first encountered. It was decided that the project was interesting enough to warrant its continuation. The decision whether and when to communicate the preliminary results was left with the chief researcher Wohlstetter.

The study continues -- Because the preliminary results indicated that the fourth alternative was the preferred one, the study continued in "an almost **a fortiori**" approach.

> "That is, a deliberate effort was made on the comparisons <u>not</u> to make assumptions or estimates that would "help" this particular system." (Quade, 1964a, p. 30)

At that stage assumptions were rechecked, effectiveness and costs were (re)calculated under a variety of different conditions; new variables were interjected, and their effects on the data estimated; relative sensitivity to errors in estimations of uncertainties were assessed. Data, quantitative (like transportation and manpower costs at different locations) and qualitative (like the political issues involved in acquiring bases) were collected.

The study was, in a sense self-directing. Reflecting on this study Quade says:

> "In analysis, the problem never remains static. Interplay between a growing understanding of what it involves now and might involve in the future forces a constant redefinition ...
>
> The process of analysis is an <u>iterative</u> one. Each hypothesis serves as a guide to later work tells us what we are looking for while we are working." (Quade, 1968a, p. 37)

Main results -- By the end of the spring 1952 a draft of the study was completed. The painstaking work of the team culminated in a 400-plus pages of the draft and numerous supporting papers. The results were conclusive.

> "The analysis pointed toward the shattering conclusion that in the last half of the 1950's the Strategic Air Command, the world's most powerful striking force, faced the dangers

> of obliteration from enemy surprise attack under the then--programmed strategic basing system." (Smith, 1966, p. 208)

In more technical words, the study had shown that in case the Russians should strike first with nuclear bombing against SAC, then, for either one of the first two alternatives, the result would be severe losses to SAC. Under conditions like this, it appeared that SAC would lose its deterring capacity. So the recommendations were to locate the bases well within the U.S. such that the radar network would be able to provide enough warning time to enable evacuation of bases in case of a Russian attack. Air refueling was found to be exceedingly expensive and more vulnerable than the use of ground overseas refueling. So the recommended alternative was the fourth one.[6]

Communicating with the Sponsor -- About the time when a draft of the study was completed, late in the spring of 1952, Wohlstetter began to spread the news among some Air Force officials. The contacts became more and more intensive towards the end of 1952. This phase was "also the beginning of the sizable feedback of questions for further study" (Smith, 1966, p. 210). In a more contemporary terminology it can be seen as a "phase-in" period in which there is an overlap between design and implementation.

The study called for a remarkable change in ways of thought about national security, military doctrine, build-up of forces and their deployment,and in the required aviation technology. To be effective, it cannot be put before the sponsor with the attitude of take it or leave it. By January 1953 Wohlstetter became confident that the findings should be presented formally to the Air Force. He gained the approval of his division head, C. J. Hitch and of top RAND management. He also received the support of some sympathetic Air Force officials. A short version of the study -- a "staff report" -- was sent to the Air Force in March 1953. With this the communication with the sponsor entered its intensive phase which lasted for about eight months. In Washington D.C. 92 briefings were given. Sixteen charts were prepared for the main briefing; to answer questions which were raised seventy charts were added. Wohlstetter was also busy with individual discussions and confrontations. Finally, not without being bogged down for a while because of internal Air Force politics, the decision was taken in the Air Force Council in October 1953 to virtually adopt the recommendations of the study.

The impacts --

(i) Adoption by the Air Force: Following approval by the ad-hoc committee, the Air Force Council

> "reached a decision on the following essential points: (1) The vulnerability of air-base facilities should be recognized in all Air Staff planning and action; (2) A hardening program should be initiated on critical facilities in overseas bases; (3) New overseas bases should be constructed to the specifications of ground-refueling functions; (4) Exceptions to these instructions will require special justification; and (5) Vulnerable stocks of materials on overseas bases should be reduced." (Smith, 1966, p. 234)

The Council's decision was ratified by the Air Force Chief of Staff in November 1953.

(ii) Implementation: Within a relatively short period, changes in the Air Force plans and procedures began to take place. The operative plans were changed from a conception which called for the overseas deployment of a substantial portion of the strike force, at the break of hostilities, to a conception of bases well within the U.S. (the Zone of the Interior), and the use of overseas bases, in case of war, for refueling only. Construction plans were changed as well. Vulnerability of bases was decreased by hardening some facilities, by dispersing facilities and by building a larger number of cheaper bases (e.g., by building narrower runways) in order to complicate the enemy's problem in launching a surprise attack. Various levels within the Air Force hierarchy had to undergo changes as a result of implementing the study's recommendations. These included the functional command level, the Air Staff units for war plans, logistics installations, personnel and others. The fate of the recommendations was not the same. Some were fully adopted, some were only partially adopted, and some were never adopted. Some of the changes went into effect almost immediately; others were realized later. A follow-up research to the basing study was undertaken. It led to some further specific changes in the Air Force procedures.[7]

(iii) Changed Vision and Policy: The most fundamental change that occurred following the adoption of the Basing Study's recommendations was the recognition that only a first (nuclear) strike capability is not enough for deterrence. Deterrence requires a second strike capability. This vision was formally incorporated into U.S. national security policy by Secretary J. MacNamera (Smith, 1966, p. 214; Friedberg, 1982).[8]

(iv) Increased Effectiveness and Efficiency: The adoption of the above described changes contributed to increasing the effectiveness of the SAC (and the Air Force in general) in carrying out the major mission of deterring the enemy and of striking the enemy with strategic bombing in case deterrence fails and war breaks out. The increased effectiveness was due to the securing of second strike capacity by the changes in the operative and construction plans, which were followed by technological changes like those in the development of new aircraft. It was also estimated that by the end of the 1950's, the savings in costs due to the study amounted to over one billion dollars.

Continued positive appraisal -- The study was regarded as successful by all the parties concerned. The sponsor, the U.S. Air Force, not only appraised it positively, but adopted it and implemented most of the study's recommendations (Smith, 1966, p. 234; William, 1975, p. 77). The advisor, the RAND Corporation, used this study, following its declassification, as the text book example of system analysis (Quade, 1964; Quade and Bouscher, 1968). During MacNamara's term of office as the Secretary of Defense, a full blown defense policy was erected upon the study's distinction between first and second strike capability (Smith, 1966, p. 214; William, 1975, p. 77; Rowen, 1979; Friedberg, 1982). The commitment to assure second strike capability in order to exercise deterrence is still held by President Reagan's administration as a pillar of its defense policy. It is one of the few principles that survived a reevaluation process of the inherited military doctrine (Weinberger, 1986, pp. 675-677).[9]

By this it is shown that the SACBS of 1951-1953 answers all of the five criteria posed above for a case of a successful policy analysis. In the sequel the differences between RVR and the R-concept used (maybe implicitly) in this successful study are exposed. These traits will throw some light on the main question (MQ). Based on them an R-concept is articulated in the next chapter, and contrasted with more familiar ones.

4.2.2. **Searching for the right problem**: Granted that the SACBS is a case of a successful policy analysis, our task is to articulate and examine that R-concept by which that case can be rationalized. A perspicuous feature of this case is the conscious search for the right question, or the problem, taken by Wohlstetter. It is quite clear that this search, which culminated with the substitution of a new problem for the sponsor's one, was a watershed in the fate of the basing study. Its unusual success hangs on it. Had Wohlstetter accepted the Air Force's formulation at its face value, the product of the study would have been, in all probability, just another undistinguished study of logistics (Smith, 1966, pp. 200-201). An R-concept which is incapable of rationalizing this move is, therefore, inadequate for a theory of policies.

Three issues (at least) are involved with the notion of "a right problem": the sense, the method and the criteria for it. First we see the answers implicit in the case study itself. Later an attempt is made at some generalizations.

The sense of "a right problem" or "a right question" in some situation has ultimately to be determined by an appropriate theory of problems. But to assume such a theory as an appropriate one for policy issues is somewhat question begging. For it is quite clear that one's theory of problems and theory of rationality cannot be mutually independent.

Without any concept of rationality, if only a partial and vague one, no concept of problems can be developed or make sense, and without some concept of problems, if only implicit and fragmentary, rationality is but an epiphenomena.[10] Because of this interdependence it is unfruitful to try to begin with a theory of problems in an attempt to characterize what is "a right problem." Instead, we turn to examine what was found wrong in the Air Force's formulation of the problem. Three (related) types of disadvantages can be specified.

(1) It was too narrow -- it took as its focus the costs of acquiring, constructing and maintaining bases in foreign countries. The study revealed that even if the economy of costs is taken as the objective and criterion for the basing decision, the base choice could affect other costs as well. For example, the costs of extending the range of bombers, which may be required as a result of some base choices. It became clear that it was not right to base the decision on economy in base costs alone.

(2) It ignored systemic efforts -- the base choice was shown to

affect critically the composition and destructive power of SAC. For example, the types of bombers and their numbers were found to depend on the base choice, especially under budgetary constraints. The capabilities of the bombers were also shown not to be independent from the base choice. Thus, the destructive power of SAC was shown to be dependent on the base choice.

(3) It endangered the major mission of SAC -- when SAC is considered as a whole -- as is suggested by the above considerations -- the base choice was shown to be critical in securing SAC's capability to carry its major mission. The issue of base vulnerability was shown to be dependent on base choice. Moreover, for some base choices it was found that the bases vulnerability is dependent on the order of strike (i.e., which side strikes first). Thus, deciding the basing study according to local costs economy could have sacrificed SAC's capability to carry out its major mission for some monetary savings.

If these factors lead to wrong problems (and questions), their opposites may be required for right problems (and questions). But the matter is not that simple. It is much easier to substantiate a claim that a certain formulation is wrong than to detail a general prescription for a right formulation. How broad should a formulation be in order to be a right one? Churchman (1968) is ready to go to the extreme. From the assumptions that everything in our world is connected to everything else, and what seems to be an improvement from the point of view of a certain system may be a deterioration from the viewpoint of a more comprehensive system, he argues that only from the viewpoint of the whole system can any judgment of improvement be made and defended. Our predicament, according to Churchman is that the (full) knowledge of the whole system is not available to us. So we must make strong and risky judgments without being able to defend them completely. Without being committed to Churchman's assumptions it can be claimed that to settle the issue of the required scope of the formulation of a problem and the comprehensiveness and intensity of the assumed systemic connections no "correspondence" with the "outer world" is or can be available. Were such a correspondence a possibility, why did not the Air Force use it in the first place? Why did not the RAND team which devoted about two years of intensive work on the study simply "look outside" and check the alleged correspondence? That there is not any "outside" "right problem" can be seen, for example, from an examination of some considerations which led to restricting the scope of the problem.

> "Basic choice was also affected by the kind and number of aircraft in the force. For any study to affect force composition except marginally seemed impossible since this is largely governed by research and development, the international situation, and Congress -- three areas of great uncertainty. Consequently, it seemed more useful to suboptimize -- to give advice about basing a force that was very likely to come into existence *rather than to work out the ideal basing system* for a theoretical optimum force that had little chance of being bought. *To limit the problem*, therefore, a decision was made to accept as given the forces then programmed for the 1956-1961 time period." (Quade, 1964a, p. 26; italics added)

This passage shows that the search for the right problem in the SAC basing study was not terminated either by the use of some mechanical rule, test or criterion indicating that the right problem was hit upon, nor by a correspondence of the "true" problem with some externally given reality. On the contrary, the termination, as well as the initiation and direction of the search for the right problem was directed by risky judgments and decisions. These included judgments about the breadth of the problem, the appropriate comprehensiveness of the systemic connections which should be taken into account, i.e., the boundaries of the problem and the intensity of connections within the system to be decideu, and the major mission of that system. Such judgments if they are not arbitrary have to be based on knowledge which is typically richer in kind and scope from what may be known at the beginning.

The advantage of the analysts is their approach:

> "[The analyst's] only possible advantage lies in analysis. That is, the process of problem solving itself has to be the subject of analysis ...
>
> "Interplay between growing understanding of what it involves now and might involve in the future forces constant redefinition [of the problem] ...
>
> "We have to solve the problem that exists. It calls for us to extend the boundaries of the problem as far as is required, determine which interdependencies as significant and then evaluate their combined impact." (Quadι, 1968a, pp. 36-37)

The sense of "a right problem" which emerges is chat a right problem (i) is neither too narrow nor too broad, (ii) assumes appropriate determination of the boundaries and connectivity of the system under discussion and, (iii) is determined with regard to an appropriately assigned major mission. The issue of the major mission is intimately linked to the objectives (of the policy under discussion). It is discussed in 4.2.3 below.

The method used in the SAC basing study to find the right problem can be characterized as empirical,[11] iterative[12] and dialectic.[13] The starting point was the original Air Force formulation of the problem. This formulation was tested to see whether there are other factors that might influence the final decision besides those, like economy in local costs, which were implied or assumed by the original formulation. When it was found for example, that the total cost of SAC was strongly sensitive to some basing choices then the original formulation was shown to be deficient in this respect. At each stage of the study, some hypotheses were raised and tested. The tests were empirical, by collecting or simulating relevant data, processing it and comparing it with the hypothesis. As the knowledge of what was involved in the basing issue grew new hypotheses were made, and so on. In general terms the hypotheses pertained to effects of and dependencies between conjectured bases choices and some suggested factors. These factors (e.g., maximum payloads of aircraft, range of bombers, routes to enemy's targets, ground vulnerability to enemy's attacks) expressed the widening perspective and the comprehensiveness and intensity of the assumed systemic connections (within SAC and between SAC and the assumed enemy).

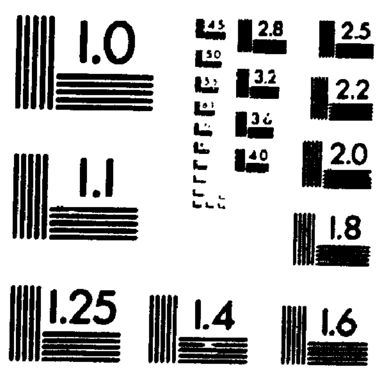
There was not any simple criterion of being "a right problem" in this study. As the study progressed so grew the conviction of the RAND team in their formulation, and the arguments they could have provided for it. For it became clearer and clearer that by their formulation new light was shed not only on technicalities of base acquisition and construction, but, more importantly, on major issues of defense policy. As the results of various tests of hypotheses converged on to a certain problem (i.e., their (re)formulation)--including the determination of the systems involved, their boundaries and relevant connections to a particular solution, so it was made apparent that RAND's problem was the right one. To be more concrete; when repeated tests and simulations showed that when the SAC system is confronted with the enemy system, there is a stable difference in the SAC's sensitivity to the order of strike, between some alternative basing schemes, it became clear that RAND's formulation of the problem was superior to that of the Air Force. For that crucial difference in vulnerability, which pertains to the SAC's capability, as a whole, to carry out its major mission under real conflict conditions, could not be seen and taken into consideration had the Air Force formulation been accepted literally. From this perspective the whole study can be seen as an attempt to articulate the right problem and a solution to it. In other words, <u>the search for the right problem and the whole policy study are co-extensive</u>.

4.2.3 Critically Scrutinizing and Deliberately Setting of Objectives: Related to the search for a right problem is the treatment of objectives. The terms used here to discuss the issues are similar to those favored by RVR. An action (actual or contemplated) is taken to be about the achievement of some objective(s). This way of talking prevents splitting the choice function to context-restricted subfunctions. Similarly with property γ. If x belongs to the choice set of every subset of alternatives in some class of such subsets, then, in the abstract, there are no reasons why x should not belong to the choice set from the union of the subsets within this class. Good reasons for this pattern require some appeal to the particularities of the context.

It is not surprising to see that both properties α and γ are implied by PCA (2.2.2). It is quite clear that if α does not hold then maybe there is not any set of "winners." Assume that $T = \{x,y,z\}$, $S = \{x,y\}$, $C(T) = \{x\}$ and $C(S) = \{y\}$. In this case x which belongs to S and T and to C(T) does not belong to C(S), though $S \subseteq T$. So that α is not satisfied. But then also PCA does not hold, for there is not any element which is in the choice set of every subset to which it belongs. By this it was shown that not property α implies not PCA. Thus, PCA implies α. That property γ follows from PCA is immediate. Simply take L in PCA to be $\cup_j S_j$ in γ.

Sen showed (1986, p. 1098) that the joint satisfaction of α and γ is equivalent to the binariness of the choice function. The binariness (or "normality" or "rationalizability" as it is called in the literature) of a choice function C means that the revealed preference relation which is generated by it (2.1.10) is adequate to generate back the choice function C itself. As PCA implies both α and γ it implies the binariness of any C which satisfies it. In other words, the binariness of C is

3



about actions is common in our folk-psychology and in many theories which implicitly or explicitly embrace RVR. The use of these terms does not imply any acceptance of RVR for policy contexts. On the contrary, it will be shown that objectives were treated in defiance of RVR.

When actions are seen as about the achievement of objectives, a problem is characterized as the choice of some members of a subset of the set of given alternatives having specific properties (Newell and Simon, 1972, p. 74; Nickles, 1981). Relative to such a characterization, the relation between problems and objectives is immediate. Given an objective, O_1, there may be some problems, relative to the possible different circumstances, concerning how to reach, do or have O_1. Given a problem, P_1, it can be analyzed as about the reaching, doing or having O_1 (which is its objective). Thus, when the circumstances are given, the relation between objectives and problems is one-one. A change in the problem (resulting from the search for a right problem) means _inter alia_ a change in the objective(s) (as long as the circumstances remain the same).

In the SACBS the changes which occurred in (the formulation of) the problem and in the objectives can be seen as complementing aspects of the same process of inquiry. As new questions about matters of fact were asked (e.g., about the kind and intensity of relations between some components of the SAC vs. Enemy system), new problems about the bringing about of some preferred states of this system were posed, and with them the objectives -- those preferred states of the system -- were sometimes changed. The initiative could have been on either side.

Reflecting about this study and others Quade (1964b, pp. 156-157) has this to say:

> "The tendency [which is] all too frequent is to accept the original statement of what is wanted exactly as proposed ... In fact ... the major job may be to decide what the policy maker should want to do."

Hitch (1961), who headed RAND's economics department in which the basing study took place, discusses at some length the question of the choice of objectives. Hitch argues that the objectives cannot be taken as given, because ends and means interact in a complex way. Among the difficulties involved in taking objectives as given Hitch mentions the following: (i) Appropriate objectives cannot be defined without knowing about the feasibility and cost of achieving them. Analysis is required to provide this knowledge. (ii) Official statements of national goals tend to be non-existent or so vague as to be non-operational. (iii) Because of the futurity of relevant objectives uncertainty surrounds the relevant circumstances in general and the actions of influential personages in particular. (iv) Objectives are multiple and conflicting. Therefore trade-offs should be made between them, which means that none of them can be taken as given.

Under such circumstances the dichotomies between means and ends and between facts and values tend to blur.

> "We must learn to look at objectives as critically and professionally as we look at our models and our inputs. We may of course begin with tentative objectives, but we must expect to modify or replace them as we learn about the systems we are studying -- and related systems. The feedback on objectives may in some cases be the most important result of our study." (Hitch, 1961, p. 49)

If there is a feedback from matters of fact -- the states of the system under study -- to matters of value -- the objectives -- then these cannot be regarded as strictly distinct. But the connection is even stronger: without a prior (if tentative) acceptance of a major mission to be carried out or accomplished by the system to be studied, which is a value judgment, the boundaries of the system to be studied cannot be determined, and so the relevant matters of fact about the system cannot be recognized and learned.

The major mission accepted in the SAC basing study was strategic deterrence of attacks either on the U.S. itself or on its European allies, and in case deterrence fails, bombardment of targets within the enemy's territory (Wohlstetter, 1964, pp. 117-120). The study proceeded from bottom up. As the problems studied became broader and broader, the objectives became more and more comprehensive and abstract. The highest objective which limited that process was the above described major mission. It is expressed in very broad terms which can receive different specifications in different circumstances. The major mission was investigated concerning its feasibility, cost and effectiveness, under some range of circumstances which were deemed plausible. But it was not investigated whether and how it contributed to some higher objectives. For any higher objectives are outside the plausible boundaries of SAC. As a military branch SAC's mission at war is strategic bombardment. This is its <u>raison d'etre</u>. In times of peace it participates in the strategic mission of the U.S. armed forces which is deterrence. Higher objectives such as disarmament (mutual or unilateral) have to be settled by higher levels in the political arena and not by the SAC itself. When the SAC's mission is determined the search for the right problem can be directed and terminated. It is a search for the highest problems (in terms of abstractness and hierarchial levels) related to the highest objectives consistent with the accepted major mission under those circumstances judged plausible. When the major mission is settled upon, the relevant matters of fact such as the system's boundaries can be recognized, and the relevant objectives be determined. Risky judgments are involved through and through in these settlements, recognitions, determinations, and the selection of the plausible circumstances. An example which shows the mutual dependence of objectives and facts, and the relevant system is the following passage from Wohlstetter (1964) where he relates to the experience gained in the SACBS.

> "The vital divergence between an objective of getting a first strike capability and the objective of getting a second strike capability did emerge but only in the course of extended empirical work. The base study ... proceeded by a method of successive approximations. It compared forces for their efficiency in carrying a payload between the bases and targets without opposition either by enemy interceptors or enemy bombers. Then it introduced obstacles successively, first, enemy defenses; then the enemy bombardment of our own bombers and other elements needed to retaliate. In essence then, the alternative systems were tested for their first strike capability and then they were

> compared for their second strike capability. And the programmed system performed in a drastically different way, depending on the order in which the opposing side struck. In the course of analyzing countermeasures and counter-counter measures, the enemy bombardment turned out to be a dominant problem. This was true even for a very much improved overseas operating base system. The refueling base system was very much less sensitive to strike order. It is only the fact that strike order made such a difference among systems contemplated that gave the first-strike second-strike distinction an interest. And it was not known in advance of the analysis that few of the programmed bombers would have survived to encounter the problem of penetrating enemy defenses which had previously been taken as the main obstacle. The analysis then not only was affected by the objectives considered, it affected them." (pp. 125-126)

The mutual dependence of value judgment (objectives) and matters of fact (system's characteristics) is immediate in this passage. Without the accepted major mission there was not any point at looking for deterrence capabilities under various circumstances. Maybe the search should have been continued for even broader problems and more comprehensive objectives. Following its acceptance, questions of relevance, such as the system's boundaries had to be settled relative to it. Both deterrence and bombardment relate to interactions with the enemy. It became evident that the basing system for SAC should have been investigated for its sensitivity to various acts and measures by the enemy. The results were that deterrence could not be abstracted from either attrition (of the attacking force) or ground vulnerability. By studying facts related to ground vulnerability, the objective of having a second strike capability emerged. From then on all the SAC basing systems under study had to have this capability. This objective, in its turn, directed the search for matters of fact related to gaining and maintaining second strike capability.

On the basis of this discussion it can be claimed that the treatment of objectives in our case study was in defiance of RVR. According to RVR fact and value are strictly separated. Values determine ends, facts are related to the efficiency of alternative means in attaining the given ends (Simon, 1957, Ch. III). In the SAC basing study value judgments and matters of fact were interrelated. And so were means and ends. A problem, accordingly, cannot simply be characterized as the selection of a means from some set which has some preferred properties in terms of the given end.

4.2.4 Approaching the Study: Among the more significant characteristics of the study which distinguish it from RVR related approaches are the following: (i) relaxing self-imposed constraints; (ii) aiming at design as well as evaluation; (iii) unravelling the systemic nature of the problem; (iv) self-reflection as a mode of study; (v) emerging conceptual novelty. As a result of these the approach is capable of dealing with discontinuous change such as the one brought around mid-century by the appearance of nuclear weapons. SACBS was able to expose some of these discontinuities, and to suggest new and appropriate policy, strategy and deployment of forces.

4.2.4.1 Pragmatic methodical doubt or relaxing unjustified self-imposed constraints: From our vantage point of view, a technique can be discerned in the approach taken by the RAND team which was later termed the relaxation of unjustified self-imposed constraints, or "ideal system design." According to this technique all the conditions used to describe a system and its states are seen as constraints. At the start all such constraints are regarded as self-imposed by the decision-maker and not as rooted in a relevant external reality. As self-imposed they are regarded as unjustified unless, and to the extent that, they are shown to be justified. A justified self-imposed constraint is one that without its inclusion the issue under discussion cannot be treated. Constraints which express a temporary technological limitations will be included only if it is shown that for the time period relevant for the decision under discussion systems which do not include them are unfeasible. In addition the system should be capable of learning and adaptation (Ackoff, 1970, 1978; Ackoff and Vergara, 1981). The use of essentially the same technique in the SACBS is illustrated by two examples; of relaxing an unjustified constraint and of including a self-imposed but justified one.

The phrase 'doctrine of action' serves in the military jargon for the basic conceptions relating to the use of force: the circumstances under which and the ways in which force is to be used. A doctrine of action can be said to constrain the possible actions of the military. The relevant doctrine in the SACBS related to the strategic bombardment mission of SAC. Based on the lessons of World War II, the available and the then projected technologies (of aviation and bombardment), and an estimate of the enemy's (mainly the U.S.S.R's) capabilities, the SAC was supposed, under this doctrine, to retaliate to a Soviet invasion of Western Europe by using its existing and projected medium-range bombers against targets within the U.S.S.R., from overseas bases close enough to the enemy's borders. This proximity was taken to contribute to greater flexibility in selecting the routes to the targets (which means decreased attrition of the attacking bombers). The then recent success of the same doctrine (against a different enemy, of course) in WWII made this doctrine seem not only reasonable but almost inevitable. It was this doctrine which had rationalized the original Air Force's formulation of the problem to be studied. Indeed, under this doctrine, the needed bases should have been built close enough to the borders of the U.S.S.R. The only problem was how to utilize efficiently the funds for those bases. But this doctrine was soon to be discarded. For it was exposed as unjustified, because the close bases system was shown incapable to function following a surprise nuclear attack, following the actualization of the then potential acquisition of nuclear weapons capability by U.S.S.R, should such an attack take place. By this the doctrine was shown to be an unjustified self-imposed constraint.

The alternatives which were called for, because the then prevailing doctrine was rejected, could have been different from the original doctrine and system in any aspect except the functional one; they all were supposed to be capable of performing the same function (of deterrence and in case deterrence fails, of strategic bombardments). In other words the major mission should have remained the same.[14] But not all the alternatives were regarded as worth studying. As brought above it was decided "to accept as given the forces then programmed for the 1956-1961 time period" (Quade, 1964a,

p. 26). This decision to accept a self-imposed constraint (on the set of alternative kinds and numbers of aircraft in the force) as justified was taken because of the perceived inability to influence significantly force composition,

> "since this is largely governed by research and development, the international situation and Congress -- three areas of great uncertainty." (Quade, 1964a, p. 26)

In the words of Wohlstetter:

> "Requirements" are not deliverances from heaven ... no one can judge them on the basis of intuition and experience alone ...
>
> The scrutiny of constraints is one of the most fruitful aspects of a thoughtful systems study." (1964, pp. 116-117)

4.2.4.2 **Design as well as evaluation:** The design, or invention, of new alternatives is a characteristic of the deliberation process in the SACBS. Indeed, it was an inevitable step once the original formulation of the problem was discarded. Any new formulation of the study's problem called for new potential solutions. Thus, the alternative which was finally recommended and later implemented, according to which the bombers should have been stationed in bases well within the borders of the U.S. in wartime and that overseas bases should be used for ground fueling only, was not called for consideration under the original formulation which had to do with cost efficiency in building operating bases overseas.

The design of new alternatives may be required because of some combination of the following factors:

(1) When the situation we (human beings) deliberate upon is complex enough, it may happen that we begin to sense that maybe an incipient problem is emerging, long before we know enough about the situation. In SACBS the Congress and Air Force felt that there is a need to prepare for the possibility of nuclear war with the U.S.S.R., but, as the unfolding of the study revealed, they had not known some of the most important factors about such a situation, e.g., the issue of vulnerability of SAC and the distinction between first strike -- second strike capability.

(2) A substitution of a new problem for the original one is sometimes required. It may be a first step toward appropriate treatment when the original formulation of the problem is made rior to gaining adequate understanding of the situtation. A premature formulation of the problem may be due to lack of needed information because of the novelty of the situation. It may also be due to a mistaken interpretation of available information because of unjustified self-imposed constraints or cherished but wrong conceptions. A substitution of this sort entails new alternative solutions. Again the recommended alternative in the SACBS is an example.

(3) A formulation of a problem may indicate what is to count as a solution. As the understanding of the situation grows these indications are expressed by more and more precise requirements (or constraints).[15] In weapon systems development these

requirements may concern, for example, the payload a bomber can carry, the range, altitude and speed of the bomber, its maneuverability, etc. Usually, these requirements, which express the various objectives sought do conflict with each other. An alternative which is superior in terms of one requirement may be inferior in terms of another. New alternatives are called then to achieve better performance in terms of more than just one requirement.

An example from SACBS concerns the possible use of nuclear-powered bombers. The use of nuclear-powered bombers was in itself a new alternative which dissolved the problem of locating aircrafts at operating basses in proximity of U.S.S.R., for such an aircraft could stay in the air for very long periods. For any aircraft there are the operational problems of penetrating the enemy's defenses, finding the target(s) and dropping its bombs accurately, and then going back through defenses.

> "The great difficulties of getting the extreme reactor temperatures needed for a supersonic dash forced rethinking of just what was "required." One of the new proposals would have added some chemically fueled engines to increase speed for the dash through the combat zone ... Another proposal accomplished part of the same purpose by taking the nuclear-powered plane not so much as a bombardment vehicle that itself had to penetrate defenses but rather as tug to tow the manned bomber into the combat zone. Still another took the nuclear plane as a platform for launching long-range air-to-surface missiles from outside the combat zone. Such idea for penetration could relax the rigorous inter- dependent performance requirements." (Wohlstetter, 1964, p. 116)

(4) A situation may be complex not only in terms of the multiple and sometimes conflicting requirements which have to be satisfied, but also in terms of the uncertain circumstances which may accrue. In such a situation it may be unwise to be maximally prepared for the requirements of a certain circumstance if it entails sacrificing the capability to operate under other circumstances. For such a complex and uncertain situation what may be required is the ability to function well enough under some spectrum of circumstances. Usually an alternative which meets this requirement is not to be found at the start of a study, but has to be designed based on the growing acquaintance ith the situation and its understanding.

An example from SACBS is the choice of the recommended alternative which was found to perform well-enough under both first-strike and second-strike circumstances. Another example was the selection of B-52 bombers as capable of good-enough performance with the bases staged at various flight distances from the U.S.S.R (Wohlstetter, 1964, pp. 139-148).

(5) Sometimes a newly designed alternative is required to simplify the analytic effort.

For example, one of the subproblems which required attention during the SACBS was to secure long enough usable segments of runways, even when the enemy strikes first, such that the SAC bombers would be able to take off. The direct approach to this subproblem called for computing, under various assumptions about the attackers and defenders, the "maximum continuous length of runway surviving" an enemy attack. Based on these computations, defense could have been planned, such that the required length, for the projected aircrafts under operational conditions will be secured. The vast amount of calculations which are required for this direct approach is resource consuming. Instead of these calculations a new alternative was designed. It called for providing multiple access taxiways such that it became "very unlikely that there will be any length of runway long enough to be usable without access" (Wohlstetter, 1964, p. 140). This alternative which was cheap to implement saved the much more expensive resources which were required for computation in the direct approach.

The importance of incorporating design in models of policy making and analysis, and of recognizing design as an essential ingredient in the deliberation phase -- over and above mere evaluations -- can be summed up in the words of Quade:

> "Our efforts to convince the Air Force that the study recommendations should be implemented made one thing clear. In an analysis aimed at policy-making the relevance of the many factors and contingencies affecting the problem is more important than sophisticated analytic techniques. A good new idea-technical operational or what have you -- is worth a thousand elaborated evaluations." (1964a, p. 63)

4.2.4.3 **Searching for the systemic nature of the problem:** If the systemic nature of the problem is not researched, then the only thing that can be done to "rationally" decide it is to estimate the costs and effectiveness (in reaching the given objectives) of each alternative, compare the alternatives and then prescribe a course of action. This way the alternatives are treated as given (because without such a search there is not a reasoned base for proposing new alternatives). The system deliberated upon (by assessing the alternative courses of action) is treated like a "black-box," where the costs and effectiveness are measures of its inputs and outputs, respectively. Prescriptions arrived at this way do not require prior understanding of the functioning of the system under consideration and how it relates to other factors.

A search for the systemic nature of the problem "opens the box" so to speak. What is looked after is an understanding of the interrelationships between the various components inside the system and in its close environment with which it interacts. On the basis of this growing understanding a better formulation of the problem can be suggested. This may lead to further investigations of the systemic connections and so on. Only when it becomes clear that an adequate understanding of the system under discussion has been reached (relative to the major mission, the resources available for investigation and the overall situation) can a prescription be given. The cognitive sequence involved in this approach can be put in the following slogan: "Understand first, diagnose second, prescribe third" (Beer, 1967, p. 26).

The search for the systemic nature can be discerned at various stages of the SACBS. First, the focus of the study was in SAC as a system which included (among other factors) bases, aircrafts, crews, a doctrine of action, flights from base to enemy points, penetration of enemy defense, bombing, flying back to base, and surviving enemy attacks. It was the costs of this comprehensive system which was considered relevant and not the locality costs alone (like acquiring, constructing and maintaining bases) as was suggested by the initial Air Force proposal to RAND (Quade, 1964a).

A more detailed level of investigation of the systemic nature of the SAC vs. enemy system (i.e., SAC at wartime carrying out its major mission) resulted in the understanding that only the alternative which was recommended had a deterrent effect. Two other alternatives could have invited aggression instead of deterring it, because they had only first-strike capability. As such they constituted a threat to the enemy. But once the enemy struck first, SAC would have been neutralized. So with a suprise attack on the bases according to these two alternatives the enemy would have gained a critical advantage (Wohlstetter, 1964).

At a lower level are found e.g., studies of the relationships between the total cost of SAC and various ways of increasing the radius of flight from base to target (Quade, 1964a).

4.2.4.4 **Reflective Mode**: A study which has to discover and validate its problem, which moves in a sequence of steps without a preplanned program of these steps, which may negate what was accepted at earlier stages and alter its own direction, such a study is in a constant danger of going astray, of passing points of no-return, of breaking down. It can be run blindly and succeed, nevertheless, if it has abundant time and large enough amounts of similar entities in which it unfolds, so that many opportunities are tried and although most of them will eventually fail, some of them will finally breed success. This is roughly, evolution's way, at least according to some writers.[16] But when time is narrow and there is only one entity in which the process inheres, then blind-alleys are intolerable. The process cannot be left for chance to determine its fate. On the other hand it cannot receive outside dictates (for if it does, then it cannot determine its problem, the steps require to handle it, etc.). It has to determine its own direction, progress and termination. To do this it must be self-reflective. Such a study must be capable of "tuning" itself to the realities of the situation towards which it is directed, as those realities are uncovered by its own progress.

The transformation of the problem is the most salient feature of the reflective mode used in the SACBS. To judge the original formulation of the problem as a wrong one, and to initiate the search fo. a right problem requires reflection about the appropriateness of the study and its method to the situation to be studied. The validation of the problem studied as a right problem, which ultimately was reached together with the completion of the study,[17] also requires such a reflection. The same holds for the scrutiny and determination of objectives.

What to do (study, inquire) next? This question accompanies such a study from start to end. When SACBS started it was not known what subjects will be investigated, which questions will be asked, and what kind of conclusions can be expected. It began as a study of logistics but by trying out those questions of logistics (as costs of acquiring, constructing and maintaining overseas operating bases) it became apparent that logistics was not enough. So the study moved to an investigation of the systemic nature of the problem of operating the SAC. Thus the idea emerged that the relevant system must be the system of interactions of SAC with the enemy. This raised the issue of vulnerability. But then the distinction between first strike and second strike capability emerged. Then the alternatives had to be evaluated with respect to the second strike capability. Two of them were rejected. Of the remaining two, one had enormous technical, operational and economic advantages over the other. It was recommended. The discovery that one of the alternatives had this advantage in the revised perception of the situation was regarded as an appropriate termination point, which simultaneously indicated that the right problem had been studied. <u>All these moves require reflection about the study and its relation about that which is studied whose nature was gradually being exposed by the study itself</u>.[18]

4.2.4.5 **Conceptual novelty:** A complex situation in which there is a significant measure of novelty may not be amenable to treatment by the available concepts. Some conceptual novelty may be required. When the appropriate novel concept(s) is (are) introduced a new vision of the situation may emerge. With it the right problem about the situation and its solution are much more salient.

The introduction of nuclear weapons brought a considerable novelty to the strategic position of nations and the dynamics of relationships between the major powers. Much of this novelty was still latent in the early 1950's. Thus, both the Congress and the Air Force thought about the issue of basing SAC in a way which extrapolated the experience gained during World War II regarding strategic bombing (Quade, 1964a, pp. 24-26). It was during the SACBS that a conceptual novelty appeared which changed the vision of the strategic position of the U.S. vis-a-vis the U.S.S.R. The distinction between a first-strike and a second-strike (and, in general, n-strike) capability shed new light on the issue. It became clear that any development of SAC which had only first strike capability was counter-productive. Instead of deterring aggression it incited a preventive strike by the Soviets who could have gained by it a military superiority without a threat of retaliation.

The issue of conceptual novelty is dear to some approaches in the philosophy of science.[19] It is of some interest to see how the new concept of second strike capability emerged.

As reported by Wohlstetter (1964) (see the long passage cited earlier in 4.2.3 while discussing the relationship between objectives and facts) it became clear that the forecasted performance or the SAC system depended critically on the order of strike (i.e., on who strikes first).

> "It is only the fact that strike order made such difference among systems contemplated that gave the first-strike, second-strike distinction an interest" (p. 126).

Thus, two elements took place in the emergence of that novel concept; (i) an empirical difference (in the result of the campaign or war) was found to be regular, or stable, and (ii) this empirical difference had value importance (in terms of winning or loosing the campaign or war). Generalizing this result it can be said that one of the occasions that justify a novel concept is such that (i') an empirical difference is found which is stable under a wide enough range of circumstances, and (ii') this difference has either cognitive descriptive significance or value importance.

4.2.4.6 **Adequacy for at least some discontinuities**: Discontinuities pose serious obstacles for rational treatment. Whatever rationality means, it implies that some domain is accessible to reason. But discontinuities are not that transparent to reason. By their very nature, they are unexpected. It is hard to understand discontinuities, but long experience has taught us that they occur. Unexpectedly.

> "unless you expect the unexpected you will never find [truth], for it is hard to discover and hard to attain."

Thus spoke Heraclitus.20 But how?

When a rigid predesigned method which is regarded as universal is applied to a domain containing discontinuities, it may happen that that method is incapable of handling the situation. Thus, when Bayesian theory (either as statistics or as decision theory) is applied to a domain containing discontinuities, all the probability weights (which add to unity) are "used up" by the predicates with which the application started. Discontinuities are not known at the start, by their very nature. They require additional predicates to be referred to. But these new predicates cannot receive positive probability weights. (Bayes theorem as it is well known, enables only a change of the probability distribution over the original predicates with addition of new information.) In other words, that type of learning in which novel concepts are introduced to handle discontinuities in the domain is ruled out by the use of Bayesian theory. (Suppes, 1966, 1979, 1980; Klein, 1977).

The approach taken in the SACBS was revealed as adequate, at least for some kinds of discontinuities. The adequacy for these discontinuities was gained not because it had begun with some method or model for problems of some specified kind. On the contrary. Its usefulness for some discontinuities was gained as a result of its empirical orientation. It did not dictate any particular model to the situation. Rather, by studying the dynamics of the system under consideration in fine detail, while the boundaries of the system were being broadened again and again, and the system was investigated over a widening range of circumstances, some of them quite hypothetical, the characteristic discontinuities of the system were discovered. It was discovered that if the same behavior (i.e., staging of bases, aircraft, doctrine of action etc.), vis-a-vis the Soviets, which was adequate before the advent of nuclear weapons, is continued in the area of nuclear armament, then the same behavior instead of deterring war does the opposite; it becomes an incitement for a Soviet preventive strike which would annihilate SAC. This new reality was the background and justification for the novel concept of second-strike capability. With this newly gained understanding of the domain the adequate treatment was found. The net result was that this discontinuity has never been materialized. Its surprising (and for the U.S. also devastating) actualization was prevented by its being theoretically acknowledged and practically avoided.

4.2.5 The Criterion: Robustness: The recommended alternative was not chosen because its costs were minimal, or because its benefits-costs difference or ratio was maximal. Nor was it recommended because its expected value (or utility) was maximal, or because it had the best minimax index. On such criteria, which may be appropriate for choices in other circumstances, two RAND researchers had this to say:

> "[T]he more elaborate models are useful primarily in much more stable situations ... Then even small percentage gains, arrived at by securing the exact optimum allocation, more than reward the effort involved in locating this optimum. The situation is quite different where technology and objectives both change very swiftly. The problem here is not to locate the exact peak of a rather flat curve, but generally to get on some entirely different curve. I have seen studies that try to determine the exact best way to perform an operation which shouldn't be performed at all" (Wohlstetter, 1964, p. 106).

> "[B]oth the minimax system ... and the maximum expected value system are bad. The latter is totally unprepared for the worst case ... The former is prepared only for the worst case and cannot exploit the advantages inherent in any of the much more likely, more favorable circumstances ...
>
> There is, a real problem in defining the maximum disaster we want to minimize, but we should recognize in moments of calm

> that some of the contingencies we are talking about in this connection...are not very likely and also not entirely subject to the enemy's control." (Wohlstetter, 1964, p. 144)

So, if the criterion according to which an alternative is to be chosen is not of the maximum or minimum value variety, what is it like?

> "[R]ather the objective was insensitivity -- finding a system that would work well in many widely divergent situations and even perform reasonably satisfactory in a major catastrophe." (Quade, 1964a, p. 63)

Or in Wohlstetter's terms, what is needed is "... flexible systems viable under a wide variety of alternative circumstances." Years later this criterion was termed "robustness".[21]

Such a criteria includes two phases: (i) First, that range of circumstances against which the alternatives are to be tested is determined. This range is neither given nor known in advance. Rather it has to be constructed by risky judgment so that there are no mistaken omissions and commissions. (ii) Second, the alternatives are tested, or measured, against all the circumstances in that range. A viable, or robust, alternative is one which provides good enough performance in all these circumstances.

Such a criterion assures that no matter which of the circumstances materializes, as long as it is among those in the range used to test the alternatives, the alternative chosen will provide good enough performance. It does not secure best performance under some narrow and special circumstances or the best performance under the worst case, but it provides stability of good performance. An example from SACBS concerns the choice of an aircraft for SAC's missions. The alternative which had the highest scores consisted of fighter-bombers operating under good weather and up to 250 nautical miles from the borders of U.S.S.R. But for distances up to 500 nautical miles it had poor results. For longer distances (under good weather) and for all distances but under bad weather conditions this alternative of fighter-bombers operating from overseas bases had terrible performances. Another alternative, of B-52 bombers operating from U.S. bases, scored good results for distances up to 3,000 nautical miles, and for longer distances it scored fair results, under both good and bad weather conditions. The second alternative was the recommended one, because it had a stable "good enough" performance under all weather conditions and under all the relevant distances up to 4,000 nautical miles, although for very short distances and under good weather conditions the first alternative was superior.

4.2.6 Appropriateness of a model is (also) question dependent: During the progress of SACBS many models of various types were used, such as cost models, models of aircraft performance, campaign models and others. They were used as an essential part of the effort to decide the issue of spending the allocated money for base construction. What determines the appropriateness of such a model? The phenomena -- says the empiricist answer. If a model represents accurately the phenomena, then it is appropriate. But our concern is with models used to assist decision making. The only phenomenon which is relevant is that some decision makers would like to decide (the situation), says the decision theorist. There is a theory of this phenomenon -- viz, decision theory -- which determines how an appropriate model should look. What has to be provided concerning the situation is some evaluative measures of the situation at least some of them may be subjective, like measures of costs, effectiveness, utility, etc. -- and nothing more. The rest will be done by the model. The box -- the situation -- can remain black -- says the decision theorist -- and nevertheless an appropriate model of it can be constructed.

SACBS provides a different lesson. Appropriateness of models depends both on the phenomena of the situation, and on the question asked. Although the phenomena of the situation of locating and operating SAC remained the same, the models required for the RAND problem were different from those models which were appropriate for the Air Force problem. Different models are appropriate for the strategic and operational issues of the composition, location and doctrine of action of SAC for a nuclear war and for the logistic issues of the requisition, construction and maintenance of overseas bases. With the shift in the questions asked, different models became appropriate.

> "For most phenomena there are many possible representations; the appropriate model depends as much on the question being asked as on the phenomena about which it is asked. A town can be modeled by a map if the question being asked is how to walk from A to B; but if the question is how to speed up the flow of traffic between the same two points, a much more elaborated model may be needed. The point is that there are no "universal" models -- that is to say, no one model that

can handle all questions about a given activity." (Quade, 1968, p. 50)

The lesson from SACBS is that for a complex and new situation the box should not remain black; it should be opened. The situation should be decided not only by theories of the phenomena of deciding, but also by considering that new and complex situation as it reveals itself in response to the questions asked about it. When there is a well-established theory of the situation then that theory decides both what is a right question about the situation and also what is an appropriate model of the situation. But when a new and complex situation is confronted, and as such it cannot be known in advance that it belongs to some specific type, then what is to be regarded as a right question about it can be decided only as a result of a learning process. In such a process the nature of the situation is gradually exposed, partly through the various questions asked. Any model of a situation like this is question-dependent.

If the decision theorist is right, at least regarding some situations whose nature is known in advance, then the following generalization is suggested: A question free representation (of a situation by a model) can be achieved only for situations which are known in advance. The relevant knowledge is (i) of the nature of the situation type (like its structure and dynamics), and (ii) the recognition (or identification) of the situation under consideration as a situation of that specific type.[22]

4.2.7 Organizational Factors Contributed to the Success of the Case:

The success enjoyed by SACBS was partly due to some organizational factors. These factors include relations between RAND and the Air Force and internal relations within RAND.[23]

4.2.7.1 **RAND and the USAF:** The relationship between RAND and the U.S. Air Force was described by an outside researcher as a "confidential advisory relationship" (Smith, 1966, p. 219). As an outside research institute, located remotely from the USAF headquarters, RAND was independent of the daily controversies and power struggles within the Air Force command. This, together with some early successes, helped RAND to achieve a reputation for objectivity. The non-involvement with the day to day events within the command contributed to developing RAND's capacity for long-range viewpoint and research. The close ties which RAND maintained with the high command of USAF were instrumental in both the ability to receive all the needed information from the Air Force and in exerting influence on the Air Force following the completion of SACBS.

This status of RAND gave it the opportunity to conduct research in a conducive setting. The researchers in California felt free to reformulate the problem. They were not tied by the intellectual commitments which prevailed in Washington D.C. They could entertain heretical ideas with neither being a threat to nor being threatened by peers and superiors. They enjoyed a long incubation time for their ideas without exposing them to premature but lethal criticism. After the conclusions had been reached, they were able to use their ties with the high command to overcome inertia and resistance to change which appeared among some ranks in the USAF command, although everybody agreed intellectually with the study's conclusion. The study was on the verge of being sent to oblivion. Without this intervention it would likely not have been accepted.

This last point deserves a closer look. In 3.1 above it was argued that endogenous uncertainty which is due to organizational factors -- i.e., uncertainties which are not related to states of the outside world but to internal states of the organization -- not representable by decision theoretic models. A lesson that can be learned from SACBS is that these endogenous undercertainties can be taken care of by organizational means, instead of trying, in vain, to accommodate them by decision theoretic models.[24] There was resistance to the changes recommended in the study because of jurisdictional questions, internal controversy in the USAF command concerning the advantages of a "big bomber", inertia, and "the prospect that substantial changes might be interpreted by rivals as an admission of error on a vast scale" (p. 223), fears of becoming involved in congressional investigation etc. When this resistance reached a stage where it looked "that nothing would get done," a delegation from RAND asked and was granted an appointment with the acting Chief of Staff of the Air Force. RAND's delegation included its president, two vice presidents and Wohlstetter. "This interview proved to be an important turning point." So instead of pre-calculating and taking a course of action which somehow averaged this probability of resistance, an organizational means was used, which was available because of the special (organizational) status of RAND within the Air Force community. That endogenous uncertainty was absorbed. The study reached acceptance and implementation.

4.2.7.2 Internal relations within RAND: RAND created and maintained an environment which was conducive to creative and penetrating research. Among the organizational features which contributed to the success of SACBS the following should be mentioned:

(i) RAND's practice was to assign projects only to interested researchers and not to thrust it on anyone. Only after Wohlstetter expressed his interest in the basing issue, following a week of reflection on the study's potential, the Air Force was informed by RAND that it agreed to undertake the project.

(ii) RAND provided a resourceful environment and a cooperative atmosphere that enabled researchers to draw on the skills, knowledge and experience of others. Thus, Wohlstetter was joined by another economist who had also an engineering background (Henry S. Rowen who later became RAND's president). They were joined later by another economist and an aeronautical engineer. This team was helped by way of short memoranda and various calculations by researchers from the Electronics, Cost Analysis, Mathematics and Engineering areas.

(iii) The responsibility for studies conducted at RAND was with the individual researchers. Accordingly the SACBS's report was issued under the names of Wohlstetter and his team members. Behind this was RAND's practice not to take an official position on every study or advice. This practice was conducive to an atmosphere of debate about methods, standards of quality and relevant problems for investigation (Smith, 1966, p. 218). It helped to sustain that measure of internal competition and dissension which is supportive of intellectual progress.

(iv) Of the utmost importance is the opportunity to use a long "incubation period" in case the project leaders find it appropriate. It was possible because of RAND's permissive and decentralized management practices, which prevented either a premature cut-off of the project or a hasty effort to bring the findings to the Air Force without adequate evidence. Wohlstetter began his work on the study in the early spring of 1951. By the end of December 1951 he completed a preliminary review of about 100 pages in length and of which about 40 pages were graphs and charts. It was circulated within RAND as an internal working paper. The question of the vulnerability of aircraft on the ground to surprise atomic attack appeared as one of the most important issues. The preliminary review "contained many gaps and was inconclusive at points" (p. 206). It aroused opposing responses. Some opposed it because it was assumed that "U.S. aircraft could be based at a variety of points within range of enemy targets at minimum risk". Some even considered it as a waste of time and money. Others were impressed by it and thought it deserved to be briefed immediately to the Pentagon. Then it was decided by the Chief of the Economics Division, Charles Hitch, that "the study raised enough interesting possibilities to warrant further investigation" (p. 207). It was left to Wohlstetter to decide when to bring the results to the Air Force. Wohlstetter opposed any effort to communicate the results to the Air Force at a premature stage, before the conclusions were well substantiated. The communication of the result began around the fall of 1952.

4.3 An Incipient R-concept

The R-concept which is incipient in SACBS receives a more detailed articulation in the next chapter. To conclude our study of SACBS as a source for articulating an R-concept which is adequate for policy theories, a few threads should be tied. First, a triple distinction is made, according to it an R-concept justifies a method which systematize a domain which is rationalized by that R-concept (4.3.1). This distinction is used to rebuke the objection that beyond SACBS there is not a special R-concept, but an interesting method. In 4.3.2 a first attempt to characterize the incipient R-concept of SACBS is made. It becomes clear that it cannot be put into a simple and direct formula, like RVR. In 4.3.3 two arguments are brought to show that RVR is not the R-concept of SACBS, because it cannot justify SACBS's method. The first argument (4.3.3.1) is by a step by step examination of the striking characteristics of SACBS. The second argument (4.3.3.2) is an in-principle argument. It shows that the assumption that SACBS's method can be justified by RVR, either leads to an ab urdity, or else it has to be admitted that some portions of that method cannot be justified by RVR. By the result at the end of 4.3.1, this is sufficient to reject the adequacy of RVR for the method of SACBS.

4.3.1 R-concepts, methods and domains: A proponent of RVR may argue that the SACBS provides a method but not an alternative R-concept. Neither the researchers at RAND or their commentators claimed that the study offered, or was supported or directed by such an R-concept. Indeed the title of one of the chapters which served as resources for the discussion above is "Methods and Procedures" (Quade, 1964b). The turn of rationality arrives when the stage is ready for it, as a result of using an appropriate method which may resemble the one used in SACBS. In response to this objection it is argued first that an R-concept must be involved in what happened in SACBS, and then that RVR cannot be that R-concept. The nature of the alternative R-concept is sketched in broad outline. It is further refined and articulated in the next chapter.

One of the interesting side-effects of RVR is that it blinds us to recognizing some important distinctions. Earlier (1.3) its blurring impact concerning the distinction between the ontological, epistemological and systemic (descriptive and prescriptive) functions of an R-concept were discussed. Another distinction which is blurred by RVR is the triple of an R-concept, a method and their domain. Under the dazzling impact of RVR (i) a method (like the scientific method or a method for decision making) is not distinguishable from that R-concept which provides it with normative validity. For example, for Popper scientific rationality inheres in its method; in decision theory rationality is located in maximizing expected utility, which is also the method of decision theory. (ii) The domain of an R-concept is not discussed because it is believed that there is just one concept of rationality which is universally applicable, namely RVR.

It follows from AMTIT (Ch. 2) that no universally applicable R-concept is possible. It is a corollary to this argument that if the notion of rationality can be theorized at all, then there is a multiplicity of R-concepts, each of which is adequate for some domain (with specific structure). Because of this result, the RVR-related disposition to think in terms of only one R-concept which is universally applicable should be rejected. Therefore there is a need to distinguish between various R-concepts and their domains.

Granted that different R-concepts should be recognized, each of which adequate for a specific domain, is there a need to speak of methods? Perhaps methods can be collapsed into R-concepts? The domain of propositions can serve as an example. One of the R-concepts which have been suggested for this domain is to be deductively closed. Different methods have been suggested either for improving the deductive closure of a set of propositions, for checking whether some given proposition belongs to the deductive closure of a set of propositions. Some of these methods are semantic, others syntactic. They differ from each other and, more importantly, from the idea of being deductively closed. Without such methods the R-concept is inoperative regarding its domain. Without the R-concept, the methods themselves are needless. Why develop them and why use them if not because they make the normative R-concept applicable? The R-concept _justifies_ the methods, as methods for the application of that R-concept. The methods _systematize_ that domain. The domain itself is being _rationalized_ by the R-concept. Thus, there is a triple pattern: _a method which is justified by an R-concept, systematizes that domain which is rationalized by that R-concept_.

A method inheres in the interface between an R-concept and its (intended) domain. An R-concept is abstract; its domain is concrete. The gap between the abstract R-concept and the concrete domain is bridged by methods whose character is intermediary and mixed between the abstractness of the R-concept and the concreteness of the domain. It has to respect the dynamics of the domain while it brings to bear the normative idea of the R-concept, otherwise it is ineffective. Astrology, for example, provides methods of prediction of future events for individuals and for nations, but none of these methods is justified by an R-concept which rationalizes the relevant domain. Nor does astrology respect the dynamics of the relevant domains. When a method is regarded as _exclusive_ for some domain, without any prior investigation whether the dynamics of the domain is accessible to that method or not, whether it may be adequately represented as a result of the operation of that method, or whether it may be affected by the method while retaining its dynamics, then the commitment to that method had a blinding effect. One form of this effect is an implicit denial of that part of the domain which is not well captured by the method. When that method is forced upon those parts of the domain which are inaccessible to it the results are failures.

A result of the triple pattern which is used below (4.3.3.2) is the following:

(P1) If M_1 is a (normative) method for the systematization of a domain D_1, and
If RC_1 is an R-concept for the rationalization of D_1, and
M_1 is regarded as adequate for D_1, and
RC_1 justifies only some part of M_1 but not all of it,
Then, RC_1 is revealed as inadequate for D_1 and M_1.

4.3.2 **An R-concept for SACBS:** Keeping in mind the distinction between an R-concept and a method justified by it, an attempt can be made to characterize the R-concept of SACBS. To start with, an attempt to put it into a short and simple maxim -- to contrast with the maximization of expected utility -- is premature. It is related to asking a right question and, thus, arriving at a right perception of the situation, having a right problem, and, as a result, adopting right objectives. It is an R-concept which breaks the walls between facts and values. That which is the system under study depends to some degree on the objectives sought, and which objectives are right depends to some degree on the facts of the situation, such as the systemic nature of the relevant interactions. It is related to the appropriate approach for these tasks which are empirical, iterative dialectic and reflective. That R-concept is related to the criterion of robustness which can be appropriate only after the range of circumstances which should be taken into consideration was determined.

Again, the line dividing values and facts is crossed by this criterion. It is related to that process by which the predispositions for these traits which are imbedded in the organizational structure unfold in the time dimension as that organization functions.

Where is it located? Out there, in the workings of that complex of organization, ideas, actions and environment. In this respect it is like some functions in the brain. They are there, but they cannot be located.[25] The R-concept of SACBS is to be found in the appropriateness of those factors to the confronted situations and their complexities. This appropriateness can only be secured by reflective thinking about the situation, whose nature is increasingly uncovered, and those methods used for this purpose. This reflexivity requires a second-order, or meta-level viewpoint from which to issue judgment and exercise self-direction.

4.3.3 RVR Cannot Justify the Method of SACBS: The domain of SACBS was the complex of the then current and programmed composition, deployment and operation of SAC and possible alternatives to it. The method employed in this study was detailed above. It was claimed that what is required to normatively justify that method is an R-concept which differs from RVR, and whose nature was only incipient in the SACBS. But is it really so, that RVR cannot justify the method of SAC?

4.3.3.1 A step by step examination:

(i) The transformation of the problem cannot be represented as a choice of the problem-to-be from a given set of alternative problems. There was not any set of alternative problems involved in SACBS. Such a set is rather indefinite. An attempt to reconstruct this step of the study as done by (the application of) RVR, simply does not make sense.

(ii) The scrutiny of objectives is also not reconstructable by RVR. The picture of a decision maker choosing his objectives by a choice that he makes according to some maximization or preference criterion over given alternative candidate objectives (as a preparatory step towards solving his problem) by an appeal to some higher objectives which are chosen in a similar way, is absurd. It leads to a vicious infinite regress.

For, assume that for a given problem the decision maker determines an objective from level n, say O_n, as the grand-objective which is adequate for treating this given problem. The hierarchy of all the objectives, from level n down to level 1 is supposed to be derivable from O_n. Now there are two possibilities; either the determination of O_n is made by RVR or it is not made by RVR. If it is made by RVR, then some competing objectives have to be available to the decision maker in order that he will chose one of them as the grand objective. This choice, if it is not rather arbitrary has to be made according to some higher level objective, say O_{n+1}, which directs the choice (or the preferences which lead to the choice). But whence O_{n+1}? Again either it is made according to RVR or not. If it is not made according to RVR, then there has to be a non-RVR determination of objectives on level n in order for RVR to be operative on lower levels. Else, if that determination of O_{n+1} is supposed to be made by RVR, then some infinite regress is inevitable.

(iii) The design of new alternatives was a crucial step in SACBS. To represent the design of new alternatives, as a choice, or some separate choices, of those new alternatives from a wider set of possible alternatives, is indeed a bit strange. Why not pool all those "possible alternatives" together with the original alternatives and choose from this set? What kind of criteria can be used to choose the new alternatives from those "possible alternatives"? It cannot be the same criterion which is used for the final choice of the alternative to be implemented. For if it is the same criterion, then it is not the design of new alternatives anymore, but some part of the final choice. If so, there is no need to separate the "possible alternatives"-- for presumably not all of them are genuine alternatives for the solution of the decision problem -- and the alternatives for the decision problem. Whence those sets of "possible alternatives" which are not genuine alternatives? Such sets are indefinite; anything in the world can belong to them.

(iv) The emergence of novel concepts cannot be represented as a choice of those novel concepts from some set of "possible concepts." Because of the novelty of such concepts, this talk simply does not make sense. Novel concepts do not exist to be selected.

(v) The criterion of robustness is rather different from the maximization criteria associated with RVR. This was explicitly discussed in SACBS (see 4.2.5 above). To recapitulate the argument is as follows:

(a) Robustness is not maximized. A search is conducted to locate or identify an alternative (which may be among those available at the start of the search or a newly devised one) which performs satisfactorily under the range of circumstances which is regarded as relevant. But, (b) this involves judgment in an irreducible way concerning the range of circumstances under which the alternative to be adopted should be capable of satisfactory performance, and concerning the thresholds of performances. Thus, (c) robustness is multidimensional in two senses; first it involves simultaneously both the breadth of those circumstances and the thresholds of satisfying performance, and, secondly these thresholds are themselves multidimensional, because the performance of each alternative is assessed against a battery of requirements and criteria. Robustness cannot be regarded as a utility (measure) except ex-post. Following its use the robustness criterion can be represented as a utility. It can be said regarding SACBS that robustness of alternatives was found to be the best instrument for deterring and winning in case deterrence fails. But the crucial point is that this relabelling can be made only ex-post. Ex-ante, RVR considerations cannot lead, by themselves, to the selection of a robust alternative (which may be a newly and specifically devised one). Ex-post representability does not guarantee ex-ante directability.

(vi) The use of organizational structure and functioning as part of the rationality of the method of SACBS -- like the use of the special contacts with the top level in the Air Force hierarchy, or the use of long "incubation periods" and the other factors discussed in 4.2.7 -- cannot be guided prospectively by RVR. Organizational maintenance and tactics are not in the kit of tools of RVR. This kit includes only cognitive tools for comparison and mensuration.

An attempt to reject the inclusion of organizational structure and functioning within reason by drawing a kind of "internal-external" distinction and labelling these factors as external cannot succeed. Because we know[26] that organizational factors and operating procedures affect the kind and quality of the cognitive output of an organization, we cannot regard these factors as "external" to rationality. Whatever affects the cognitive output and is controllable, should be controlled. Otherwise reason concedes to accident and despair.

On the basis of irreducible differences in these six factors, the inevitable conclusion is that RVR cannot justify the method of SACBS.

4.3.3.2 **An in-prinicple argument:** Assume that each of the stages or steps taken in SACBS can be represented as done according to RVR. Each separate episode of deliberation or inquiry can be regarded as such a step (which can be represented as done by RVR). Still the method of SACBS contains an indispensable component which cannot be handled by RVR. It is the sequencing of all these steps.

If RVR has anything at all to say about the sequencing of these stages, then that sequencing consists in a choice of a sequence from among a given set of sequences according to some criterion. It is so, because the rationality of RVR is simply the choice of an alternative which is maximal, in terms of some criterion (which expresses given ends), from a given set of alternatives. This holds for sequences too. For if a sequence is just the accumulative end result of these separate stages, then the sequence is not RVR-guided prospectively.

Three kinds of problems pertain to the conception of the sequencing of the different stages in SACBS by RVR. They relate to the very notion of such a sequence, the notion of all the sequences of that sort, and to RVR-choosing between these sequences.

The very notion of an RVR-prospectively-chosen sequence of RVR-performed stages of a process involves the following difficulties;

(i) Assume that the original process (i.e., the SACBS) is composed from n basic stages. Also assume that repetition (iteration) of stages is allowed (as it was in SACBS). Then to envisage prospectively such a sequence which is composed of those n stages means that following each basic stage a sequencing stage is inserted whose job is to determine "what to do next"? But the set of answers to such a question is indefinite. If some sequence is produced although the sets of answers to these questions are indefinite, then the results are arbitrary.

(ii) Moreover, if a move like, "Now go back over the whole process by loading all the assumptions against some alternative A_1" is allowed (as it was in SACBS) then it has to be included in all these sequencing stages. But then it is a problem for RVR to terminate the sequence. Indeed, why not terminate the process immediately following the "first round"? If it is to be terminated by the end of the first round or any other round, there is not anything in RVR itself which can terminate the process. In other words, the judgment that the process, by the end of some stage, is satisfying, and that on the basis of its results a decision can be made (to do so-and-so), is taken from he viewpoint of a higher level. If RVR plays any role at all in this judgment, it must be supplemented. RVR cannot issue such a judgment by itself.

(iii) Moreover, this notion entails that the whole process is envisaged in advance by the decision maker. Otherwise the sequence is not complete and the decision maker cannot compare it with other sequences in order to select one of them. But the sequence that really took place in SACBS could not have been known prior to the unfolding of the process. It included a transformation of the problem, substituted objectives, new alternatives and novel concepts. <u>Thus, it was impossible to entertain such a sequence prior to the execution of the whole process</u>.

Even if there is a sense to such a sequence, then <u>a choice from among all such sequences is impossible</u>. Because of the allowed iteration of stages and because of the number of "what to do next" paths is indefinite, the number of different alternative sequences of that sort is unbounded. Consequently, the set of <u>all</u> sequences of the required sort is indefinite.

Even if some set of sequences of that sort were to be presented, then the notion of <u>a selection from these sequences involves some absurdities</u>.

(i) If new objectives are allowed (as in SACBS), then different objectives may emerge in different sequences. The choice between the competing sequences according to one set of objectives (which is included in one of the sequences) is arbitrarily biased. The use of the original objectives after they were substituted by new ones, is anachronistic. The major mission by itself is not enough to serve as an arbiter between different alternative actions. Objectives of an intermediary level are necessary to that. Otherwise there are not any criteria or measures to compare and evaluate the alternatives as carriers of the major mission. But there is not any available "objective" set of objectives to do this job across the different sequences, as required by RVR.

(ii) The choice of a sequence from some given sequences is in fact a choice of that alternative to be chosen at the final stage. That means that the whole process of deliberation and inquiry is collapsed into a single grand decision (Savage, 1972, pp. 82-91). But such a grand decision is impossible. Were it possible there was not any need for the study. The reality of

> the case was that a very laborious process was needed to develop just one sequence.[27]

Thus, when RVR is adhered to the following holds: Either the sequencing element is not justified by RVR, or else there is but one grand decision in which the decision maker chooses such a sequence--and by this he in fact makes the final decision -- from among some given sequences, prospectively of the process. The first case simply means giving up RVR, for it cannot fully justify the method of SACBS. The later case is a sheer absurdity as argued above.[28]

The conclusion of this discussion is that RVR cannot justify the method of SACBS. This result can be generalized to all cases of similar complexity. If SACBS is representative for (good) policy studies, then the result is again: RVR cannot be the R-concept of policy studies.

<u>NOTES</u>

(1) The following sources were used for the study of SACBS: Quade (1964a) presents a shorter version of SACBS together with some evaluations of it; Wohlstetter (1964) contains reflections on some major points of SACBS by the chief investigator; Quade (1964b, 1968) contain methodological lessons from SACBS by one of the leading researchers in RAND; Smith (1966) contains a chapter on SACBS as a model case of systems analysis.

(2) This point becomes more convincing when the trichotomy of an R-concept, a method and, a domain is discussed below 4.3.1 and 5. In a nutshell the following can be said: Because the R-concept stands in distinct relations to the domain (the scientific episode or the applied case) and to the method (the scientific method or the applied method), once an R-concept is articulated it can be used also to criticize the domain, as well as to be open to criticism from the domain. The same with respect to the relationship between the R-concept and the method. Laudan follows the standard approach which does not distinguish between an R-concept and the relevant method. But see 4.3.1 and 5.

(3) Laudan (1986) finds the following five difficulties of intuitionistic meta-methodologies:

(i) they depend on some linguistic intuition within a certain speakers community;
(ii) they deny any significant critical role to methodology;
(iii) intuitive judgments about the relative merits of rival theories differ considerably;
(iv) they contain an apparent circularity identify the best scientists a conception of the adequate method has to be used;
(v) they need to review many cases in order to issue a verdict.

(4) At that time RAND did not have any experience with policy or broad strategic questions (Smith, 1966, pp. 103-104).

(5) "But how is the analyst to know that his formulation of the problem is superior? <u>His only possible advantage lies in analysis</u>. That is the process of problem solving itself has to be the subject of analysis" (Quade, 1968, p. 36).

(6) This presentation simplifies the actual process as it is reported. Yet it conserves the points essential for evaluating the rationality of the case.

(7) "In September 1953 ... the Air Staff Ad Hoc Committee reached agreement and endorsed the study's main recommendations ... Of particular importance in the Ad Hoc Committee's report was the estimate in the Installations Section of the report that the overseas-fueling-base system would save at least one billion dollars over the programmed system in construction costs alone. "In the late October 1953 the [Air Force Council] reached a decision" (Smith, 1966, pp. 233-234) on the translation of the study recommendations into Air Force policy. "Partly as a result of Wohlstetter analysis great emphasis was placed on making the American nuclear force invulnerable ..." (Baylis, 1975, p. 77).

(8) "R-266 [i.e., the SAC-Basing Study] showed that a vital part of any viable deterrence policy had to be deterrence of an attack on the deterrent forces themselves through the provision of a second-strike strategic capability. Thus the basing study contributed to important changes in U.S. strategic thought and doctrine. The insistence on a secure second-strike deterrent force later emerged as a central element in the MacNamara strategic doctrine (Smith, 1966, p. 214). "The other key defense initiative taken by the Kennedy administration was strengthening of the U.S. second-strike, long range nuclear capacity (Rowen, 1979. p. 144). [The first mission of the strategic force program was in MacNamara's words]:

> "... to deter deliberate nuclear attack upon the United States and its allies by maintaining a highly reliable ability to inflict an unacceptable degree of damage upon any single agressor, or combination of aggressors, even after absorbing a surprise first strike."

MacNamara termed this the "assured-destruction mission" (Friedberg, 1982, p. 71).

(9) "Now five years later [viz, after Reagan's Administration entered office] I believe we have made significant progress both in strengthening our military forces and in modernizing our defense strategy and policy ...

... The label for this strategy is deterrence ... To be effective deterrence must continue to meet four tests: Survivability: our forces must be able to survive a preemptive attack with sufficient retaliability strength to threaten losses that outweigh gains" (Weinberger, 1986, pp. 676-677).

(10) From this alone it does not follow that rationality is nothing but problem-solving capacity as is argued by Laudan (1977) concerning scientific theories.

(11) "Before the analysis itself can progress, much labor must be

spent in searching out the facts of the situation" (Quade, 1964a, p. 25).

(12) "The process of analysis is an <u>iterative</u> one. Each hypothesis serves as a guide to later work -- it tells us what we are looking for while we are looking" (Quade, 1968, p. 37).

(13) "Primarily as the result of discussion and intuition the original effort to state a problem should suggest one or more possible solutions or hypotheses. As the study progresses, these original ideas are enriched and elaborated upon -- or discarded -- and new ideas are found."

"As a result , the final statement of the conclusion and recommendations usually rests on a knowledge of facts about the problem which the analyst did not have at the start" (Quade, 1968, p. 37).

(14) Ackoff and Vergara (1980, p. 7) take the first step of their idealized -- design process to be

> "Selecting a mission eneral purpose of the system to be designed that encompasses its responsibility to the larger systems of which it is a part and to its stakeholders."

Only when that mission is determined the relaxation of self-imposed constraints can proceed.

(15) Indeed Nickles (1981) even identified a problem with "a demand that a certain goal be achieved plus constraints on the manner in which the goal is achieved, i.e., conditions of adequacy on the problem solution" (p. 111). But as the example of Roentgen trying to explain the shadows on his photographic negatives shows, when the acquaintance with the situation is very low, no specific constraints are made.

(16) E.g. Hahlweg (1981) compares some models of evolution.

(17) In the words of Quade;

> "... it is impossible to formulate a problem completely before it is solved, or in other words, the final problem statement may have to be written simultaneously with the final answer" (1964, p. 158).

This is echoed by Wildavsky (1979, Chapter 16).

(18) In the words of Quade:

> "... [T]he process of problem solving itself has to be the subject of analysis ... Primarily as the result of discussion and intuition, the original effort to state a problem should suggest one or more possible solutions or hypotheses. As the study progresses, these original ideas are enriched and elaborated upon -- or discarded -- and new ideas are found. The process of analysis is an iterative one. Each hypothesis serves as a guide to later work -- it tells us what we are looking for while we are looking. As a result, the final statement of the conclusions and recommendations usually rests on a knowledge of facts about the problem which the analyst does not have at the start. "Analysis, being iterative, is self-correcting, as the study goes on, early models are refined and then replaced ... It is also important to go outside the model, to contemplate changes that violate its assumptions, and thereby perhaps achieve a better model" (1968, pp. 36-50).

(19) For example Kuhn (1962) Feyerabend (1975) Toulmin (1972) Laudan et. al (1986) present a comprehensive picture of their views.

(20) Wheelwright (1966, p. 70) (Number 18 in Diels)

(21) For example Goh (1979).

(22) This claim about representation can be generalized beyond the domain of decision making. In fact, it is a claim about representation in general which belongs to philosophy of language or to metaphysics. This line of reasoning is not required for the thesis of this dissertation. Therefore it is not developed here.

(23) This subsection draws from Smith (1966). All the citations in this passage in 4.2.7 are from the source.

(24) Wildavsky (1979, pp. 109-140) argues similarly that "cogitation" (i.e., using model based computations to solve problems) should be aided by "social interaction" (which includes organizational measures) for neither one is sufficient to solve policy problems.

(25) Bateson (1972) argues that mind itself cannot be located (especially p. 458 ff.).

(26) See, e.g., Argyris (1982), George (1980), Argyris and Schon

(1978). Cherniak (1983) sents an argument which in effect shows that some organizational factors are essential for human rationality. Thus, he is able to identify the compartmentalization of human memory and its use of non-algorithmic search procedures as necessary for human rationality. These are organizational factors, relating respectively to the structure and the operating procedures of the organization (human memory).

(27) Tribe (1973) argues that one of the inherent flaws of "policy analytic methods" is their tendency to collapse the process of policy making. By this he means the "almost universal tendency to focus on "outcomes," "impacts," "end results," and the like , while largely ignoring -- or relegating to the realm of politics -- the questions of process that bear not on where one ends up but on how one gets there" (p. 637). The argument in the main text provides an additional perspective to the phenomenon of collapsing processes. Not only a tendency to focus on end-result, but an impossibility of conceiving a choice of a full sequence of stages -- this is the situation concerning RVR-related methods.

(28) Without entering the details of Savage's system (1954) (1972) it may be mentioned that from the perspective of this argument, Savage's small world problem (pp. 85-91) is symptomatic to the framework of RVR in general and is specifically related to Bayesian statistics. The RVR framework seems to work for the grand decision, or the grand world (Savage), but this is impossible. When we turn to small decisions, or to small worlds, the process is not fully rationalized, or the probability functions used in the small worlds are somewhat arbitrary because they do not necessarily agree with the probability functions in the grand world.

Chapter 5: Context Sensitive Rationality (CSR) vs. Context Free Rationality (CFR)

"There is room for words on subjects other than last words." (R. Nozick, 1974, p. xii)

5.0 Overview

Two concepts (or rather two types of concepts) of rationality are articulated. The reason for this articulation stems from the main interest of this dissertation, viz, to identify and explicate that concept of rationality which is adequate for policy theories (including such normative theories). A corollary of Chapter 2 (discussed also in 4.3.1) is that there must be a multiplicity of R-concepts, each adequate in respect of some domain. RVR is shown not to be adequate for policy theories (Chapter 2 and 3). In order to gain some insight into that R-concept which is adequate for policy theories the case of SACBS was discussed in detail in Chapter 4. Among other things it was shown there that RVR cannot capture the rationality of SACBS. The task which should be addressed now is to articulate an R-concept, which captures the rationality of SACBS, and which is adequate for policy theories.

To be adequate for policy theories any R-concept has to enable a characterization or conceptualization of policies. It is shown above (Chapter 3) that RVR lacks this required capability. RVR is also plagued by another difficulty. It tends to be inherently uncriticizable on the basis of practical experience (3.1). Because of the peculiar way in which RVR discharges its four roles, the descriptive, normative, epistemological and ontological (1.3), it tends to be immune from external criticism. Its epistemological role -- which determines the concern, scope and shape of the main parameters of the theory -- reaffirms anew its theoretical use (either descriptively or normatively) in the face of repeated failures in application. (That it has also a constitutive (ontological) role reinforces this tendency.) The proposed R-concept should overcome this difficulty of RVR.

In 5.1 the two concepts (or types of concepts) of rationality are articulated. The notion of algorithms is discussed as a preparation for the articulation of CFR. Heuristics are often contrasted with algorithms, but are not discussed as thoroughly as they deserve. This is done here. A distinction which emerges from this discussion is between instrumental heuristics -- which receive as given the problem, the objective(s), the alternatives, and the criterion, which is of the maximization variety -- and self-directing heuristics, which do not require these as given. Most of the discussions in the literature are concerned with instrumental heuristics. It becomes apparent that whereas algorithms -- as an extreme version of formal rules --are context free, heuristics are context sensitive. This sensitivity is greater for self-directing heuristics.

Another concept which is analyzed as a preparation for the articulation of CSR is that of practices. Four layers are distinguished in a practice. The main one, called "conduct" has three phases -- deliberation, action and product. The bottom layer is that of results. Two other levels are the superstructures of traditions and institutions. Dimensions of the sensitivity to the context are discussed in some detail.

CSR is found to be the more fundamental of the two. From a participant's viewpoint CSR is sensitive to the reality it confronts, while CFR attempts to dictate its reality. From an observer's viewpoint CFR needs CSR for authorizing its actual applications, while CSR is self-sufficient because of its capability for self-direction and sensitivity to results.

In 5.2 it is argued that, indeed, CSR is a rationality concept, that it captures the rationality of SACBS. The content of a CSR-instance is dependent on states of knowledge in the practice which cannot be fully specified in advance. The normative force of a CSR-instance is expressed by the appropriateness of that concept. It is appropriate to the extent that it expresses that possible intervention of human reason with some particular practice by which the following two ensured are: (a) human reason's current potential for directing and controlling that practice is exhausted, and (b) human reason persistently strives to enlarge this potential. This involves a capacity to develop meta-levels and to ascend to them as is required by the context. From these meta-levels evaluations, judgments, direction and control are issued. CSR enables a conceptualization of policies because the self- referring property of some of the heuristics can make the recurcivity property of policy as the product of self referring practice.

5.3 sums up the discussion. The relationship to works on rationality by some philosophers is touched upon. Questions are raised for future work.

5.1 Two Concepts of Rationality

Two R-concepts, CFR and CSR are articulated below (5.1.4 and 5.1.5, respectively). As a preparatory step three notions are discussed at some length. These are algorithms (5.1.1), heuristics (5.1.2) and practices (5.1.3). The relation between CFR and CSR is discussed 5.1.6.

CFR is an extreme version of RVR, in which the formal rules take the form of an algorithm. CSR is an extreme concept of an opposite kind. Where the method of CFR is algorithmic, that of CSR is a self-directing heuristic. Practices populate the domain of CSR, while separable instrumental choices do the same for CFR. CSR is found to be the more basic of the two, because CSR is self-sufficient while CFR is not, and it too needs CSR to establish its domain of applicability.

The major portion of this section (5.1.2.3) is an explication of the not so well understood concept of heuristics. It is done by contrasting heuristics with algorithms along twelve dimensions. It seems that there is a considerable qualitative variety in heuristics. Some of them are rather close to algorithms, while others, those with self-direction and self-reference properties, are quite remote from algorithms. It is this kind of heuristics which participates in CSR.

It should be held in mind that CSR is supposed to capture the rationality of the SACBS, discussed in Chapter 4. Indeed, this is argued in 5.2 below. The characterization of heuristics and the sensitivity to the content of CSR (5.1.5.4) are better understood against the background of the SACBS. The sensitivity to the context has several dimensions, among them characteristics of the problem space, scope of the problem, the level of the deliberating unit, the scope of the deliberating unit, and the stage in the life-cycle of the problem.

5.1.1 **Algorithms:** Logic is a theory of abstract relations -- like deduction -- between abstract entities -- like statements or propositions. Definitions given in logical terms carry over this abstract quality. When algorithms are defined in logical texts, this quality is retained; algorithms are defined as a kind of calculating methods. The medium in which the calculation is performed is not mentioned. This can be seen, for example, in Church's text (1959, p. 52, note 118); an algorithm is

> "an effective method of calculating, especially if it consists of a sequence of steps, with later steps depending on results of earlier ones ..."

This characterization and similar ones (if more formal) serve the purpose of logical theory. In other contexts, abstraction from the medium of calculating is counterproductive. Computer science furnishes examples. There the constraints on calculating brought by the structural and functional properties of the medium of calculations are at the heart of the discussion. It is not surprising to find a definition of an algorithm from a logic text for computer scientists in which the medium of calculation is not abstracted.

The definition given by Korfhage (1966) is in terms of a triad relation between a method, a problem and a machine (i.e., a medium of computation). The machine does not have to be a computer or any material artifact. It may as well be a conceptual framework, a person or an organization. What identifies it as a machine is functional; that it tries to solve a problem by using a method.

> "Definition ... A method of solution for problem P on device M is a description in a language comprehensible to M of discrete steps performed by M and an ordering of these steps, such that given proper data, if M perform the prescribed steps in the prescribed order, a solution to problem P will result, if one exists. A method of solution will be called a _semi-algorithm_ for P on M if the solution to P (if one exists) appears after the performance of finitely many steps. A semi-algorithm will be called an _algorithm_ if, in addition, whenever the problem has no solution the method enables the device to determine this after a finite number of steps and halt" (1966, p.89).

Some remarks on this definition:

(i) The triad relation is seen clearly. A _method_ for solving _a problem_ which is performable on some _machine_ is an algorithm if some conditions hold. Nothing is an algorithm in the abstract. It may or may not be an algorithm for some problem, performable on some machines, depending if there is a method for solving P on M which satisfies some conditions on the method itself (i.e., being a finitary series of discrete steps such that if there is a solution it appears after a finite number of steps and if there is not a solution it determines this after a finite number of steps and halt), on its relation with the problem (i.e., that indeed it is a method for that problem P), and on its relation with the machine (i.e., that the suggested method is comprehensible to the machine because it is presented in a language which is comprehensive to the machine). The role of the machine is not accidental. Without being comprehensible to the machine M, no suggested method for solving P can be an algorithm.

(ii) In general, a judgment which can only be made at a meta-level is required to judge that anything is an algorithm. It has to be judged that indeed the desription of the method for solving P is comprehensible for M and performable by M, that the method satisfies the required conditions. But more important, to judge that the suggested method is indeed a method for solving the problem P, a meta-level is required.

Krofhage makes two observations which deserve attention. There is a trade-off between the strength of a method (for solving P) and the understanding of P. If no method for solving P is known, then a thorough understanding of P is required. If a strong method for solving P is known, then P need not be understood at all. Thus, when a strong method for book-keeping is available, a clerk can keep the accounts of a small firm without understanding the firm's finances. All that is needed is that the instructions are specified completely and in a language which the accountant understands, and that he does as he is told (p. 88). In other words, the stronger the available method for solving P, the weaker the required understanding of P.

When an algorithm for solving P on some available machine is available, then P does not need to be understood at all. When no method for solving a problem is known the only hope to treat the problem is by thorough understanding.

5.1.2 **Heuristics:** Contrasted with algorithms are heuristics. These are supposed to be approximate methods, which are useful for solving some problems. They search for acceptable solutions which are not required to be optimal.

> "Heuristic reasoning is not regarded as final and strict, but as provisional and plausible only, whose purpose is to discover the solution of the present problem" (Polya, 1957, p. 113).

> "Today the term heuristic means a method which, on the basis of experience or judgment, seems likely to yield a good solution to a problem but which cannot be guaranteed to produce an optimum" (Foulds, 1983, p. 929).

Heuristics are first exemplified (in 5.1.2.1). Then some of the main reasons for the use of heuristics are classified (5.1.2.2). Following this the nature of heuristics is explicated by being contrasted with the more familiar characteristics of algorithms (5.1.2.3).

5.1.2.1 **Some Examples of Heuristics:** Some heuristics are used in everyday life, others are found in more specific circumstances. Foulds (1983) offers the following examples of everyday heuristics; taking one's coat when the forecast is for bad weather, or changing money regularly in the bank to ensure a supply of small change on hand, or to book early in order to be sure of being able to buy theatre tickets. Heuristics of the second kind include for example, scheduling the short jobs first, or, performing tasks in order of importance (1983, p. 929). Still others include approximate methods for problems which are combinatorially complex, such as the Travelling Salesman Problem (Foulds, 1983, pp. 930-32), or the Warehouse Location Problem (Feldman, Lehrer and Ray, 1966).

In the Traveling Salesman Problem a route which starts at some point and then passes through each of N given points only once and then returns to the origin is looked for, which minimizes the total distance travelled (or some function of this distance such as time or cost). Even for a modest N the amount of calculation which is required for a brute force algorithm (i.e., for calculating the index of total distance for each of the routes, comparing the indices and selecting the route with the smallest index) is prohibitive. "If each tour could be evaluated in a billionth of a second, it would still take over 1600 years to examine them for N=21" (Foulds, 1983, p. 928).

In the Warehouse Location Problem the number, sizes and locations of service centers (warehouses; but note that also overseas operating bases for strategic air force) are determined, and the demand centers (clusters of targets) to be supplied (bombed) from which warehouses (operating bases) are decided upon so as to minimize the total distribution cost, which is the total cost of building and operation the warehouses (bases) plus transportations (flight to target) (Feldman, Lehrer and Ray, 1966).[1]

Heuristics used for these problems and others use explicit information, as well as cues, concerning the structure of the specific problem situation in order to shorten the search process by directing it to those regions of the problem space where a satisfying solution is likely to be found (Simon, 1978; Silver, Vidal and de Werra, 1980).[2]

5.1.2.2 **Reasons for Using Heuristics**: There are several reasons why heuristics are needed in addition to, or instead of, algorithms.

(i) Some problems have mathematical structures for which no algorithm is known.

(ii) Some problems are not amenable to algorithms because the complexity of computations grows exponentially with the size of the problem. Even if there are algorithms, which can be executed on available computers, for relatively small size problems of this sort, no algorithm on any computer can be used to solve them because of the exponentially rising complexity (Silver, Vidal and de Werra, 1980, p. 154; Simon 1978, p. 12; Foulds 1983, p. 928).

(iii) Some problems may be solved by algorithms, but the use of the algorithm is wasteful in the sense that the additional resources needed to optimize over and above finding an acceptable solution, are not compensated for by the increase in optimality of the solution.

(iv) Some problems may be amenable to treatment by algorithms on available machines, but the low quality of the available data -- which may be limited and unreliable relative to what is required for the execution of the algorithm -- makes it senseless to try to optimize (Foster and Foster, 1981).

(v) Some problems are too ill-defined to be treated by an algorithm (Eilon, 1977).

(vi) Some problems have available algorithms but these are not transparent to the decision makers. They may prefer understanding (of the solution procedure) to the optimality of the solution (Silver, Vidal and de Werra, 1980, p. 154).

5.1.2.3 **Heuristics vs. Algorithms:** Algorithms are used as a benchmark for the explication of heuristics. It is done by contrasting heuristics and algorithms according to several determinants. Some differences between heuristics and algorithms are thus underscored, as well as some differences between some kinds of heuristics. These determinants relate to the operation of the two approaches, their characteristic perspective, their attitude towards errors, and their typical conceptualization of decisions.

I: **In General**

A: **Operation**

(a) Prerequisites:

(i) While the applicability of algorithms demands that the problem to be treated is a well-formed (well-defined, well-stated) problem, heuristics of some sorts can be applied to some ill-formed problems. Indeed, the ill-formedness of a problem may be the main reason why a heuristic is needed.

(See point (v) in 5.1.2.2.) The issue here is a pragmatic one: Does the formulation of the problem lead to the smooth applicability of a known method for solving the problem? A problem is to be regarded as (pragmatically) well-formed (relative to some theory or to some methods) when its formulation includes a sufficient measure of information which enables a smooth reformulation of it which,

(.i) either can be seen as belonging to a class of problems for which there is a theory which specifies their structure and how to solve them, or

(.ii) some known and available method can be applied to it in order to produce what is regarded as a solution of it. This characterization is pragmatic through and through. It refers to solving problems. It refers to the smoothness of the reformulation of the problem. If a problem becomes solvable only by some tricky and indirect manipulations, it may not be regarded as well-formed in the sense given above. The available methods produce "what is regarded as solution". This pragmatic component is the core of the sense of "well-formedness" specified here. Sometimes this reformulation is in mathematical terms, and the method to be applied is an algorithm. This is a strong indication that the problem is well-formed. But being amenable to mathematical reformulation is not necessary for being well-formed. On the other hand, some problems cannot be reformulated, in the manner described above, relative to any known and available method, or a theory for some class of problems. Such problems are pragmatically ill-formed.[3]

(ii) The applicability of algorithms demands that some effective (and converging) method, performable on some available machine (including human brains), is available for the problem(s) at hand. Heuristics do not require either of these properties. Muller-Merbach (1981) defines heuristics by this lack of convergence. The lack of effectiveness of the method gives it its partial nature; that it may produce a satisfactory result but not of necessity.

(iii) Algorithms require for their applicability relatively high-quality data. There is no sense to computing exact maxima when the input data is far from being precise and complete (relative to the demands of the method). But on many occasions only rough estimates of some part of the required data can be obtained, at least within reasonable limits of time and other resources. In cases of this sort heuristics may still be useful long after the performance of an algorithm has become out of the question (Eilon, 1977; Foster and Foster, 1981; Woolsey and Swanson, 1975).

(b) Mode of Employment:

(i) Algorithms are externally initiated. There is a qualitative gap between the decision to use some algorithm, like Euclid's algorithm for division or the simplex algorithm of linear programming, and the computations by which the algorithm is performed. The move towards using such an algorithm is different from and not included in that algorithm. Indeed, as argued by Brown (1978, pp. 243-5) not only is that decision distinguished from performing the algorithm itself, but it is qualitatively different. For a decision to use a particular algorithm must, ultimately, be made by a non-algorithmic method. Otherwise an infinite succession of algorithms is required. The situation may be different with some heuristics. Although there are some heuristics which resemble algorithms in this respect --like many of those used in operations research (see Muller-Marbach, 1981) -- some heuristics are much "softer" and any dividing line between moving towards using them and their actual use is artificial. For example: for someone who has to reach the top of a conical shaped mountain which is enveloped in cloud, the dividing line between "deciding" to keep going up and the actual trials of putting one's leg in different directions in a search for the upward direction, is rather a thin and artificial one. In such a case the heuristic can be said to be internally initiated.

(ii) The processing mode typical of algorithms is a formal and routine manipulation of symbols according to a predetermined sequence of rules. Relaxing any one of these features, or some combination of them, results in a heuristic mode of processing. Thus, when predetermined rules (which hold for every occasion of application) are substituted by maxims and suggestions which are sensitive to cues, e.g., from the structure of the problem, or from global qualities of the situation, then a heuristic is emerging. When methods unique to the situation substitute for routine, when substantial judgment and guidelines replace formal rules, a heuristic is forthcoming. But the most distinctive feature of the processing mode of heuristics is that it is not restricted to the domain of symbols. It operates as well in the domain of the objects themselves. In contradiction to algorithms, heuristics sometimes processes objects, like organizational designs and institutional procedures, or to return to our earlier example, moving the person who wants to climb the cloud-surrounded hill instead of processing names of points on the hill and their accompanying haracteristics. This qualitatively wider scope of processing of heuristics makes for trade-offs to be made between more powerful and precise methods of calculations (which operate on symbols) and less precise but more flexible heuristic methods which operate on the objects (or material) level itself.

(iii) The termination of algorithms is built into them. When some finite number of fully specified operations are made (on some machine), the execution of the algorithm at hand is terminated. This is included in the idea of an effective method. On the other hand the termination of a heuristic is a matter of judgment. It requires a judgment, which is added to the mere performance of the method. A judgment of this sort compares the achievements (in a stage) of the method with the relevant part of the world and some expectations concerning it. It may decide e.g., that the methods should be performed again, or be continued, or stopped.

(c) Results: The product of an application of an algorithm is a solution (to the mathematical problem). When the mathematical problem represents a decision problem this product is an optimal solution. It is a characteristic of all heuristics that they do not guarantee the achievement of optimal solutions. They settle for approximate but satisfactory results.

B: **Perspective**

(d) Viewpoint taken: Two kinds of viewpoints can be distinguished concerning actions and problems. They are the operator's and the commentator's (or regulative) viewpoints. The operator's viewpoint is interested in the determination of what to do and how in carrying on some major mission. The commentator's viewpoint is concerned with providing a description from without of the ways the major mission is undertaken. Examples from two philosophers may illustrate this distinction. The first is Toulmin's (1953, p. 13) distinction between a 'participant's language' and an 'onlookers language'. In the first an account of a new theory is given in the terminology of the new theory. In the second, the new terminology is not used but described. Toulmin gives a specific example (p. 65) using

Snell's Law in geometrical optics.[4] His discussion can be summarized in this way: the participant is interested in accounting for some phenomena (_using_ the concepts) while the onlooker (or observer) is interested in the utilization of some conceptual framework in the attempt to account for observed phenomena (_mentioning_ the concepts).

Feyerabend (1978, pp. 16-31) provides the second example. Where Toulmin's example is from science, the domain Feyerabend uses to illustrate the two viewpoints is the interaction of practices or traditions. In this domain two kinds of interests and questions can be distinguished; the participant's and the observer's. "Observers want to know what is going on, participants what to do (pp. 18-19).[5] Participants are interested in the attitude of members of a practice or a tradition towards the intrusion by another. Observers seek the details of the interaction and historical account of it, some generalization, if possible, etc.

Thus, the distinctions of Toulmin and Feyerabend can be seen as special cases of the distinction between the operator's and the commentator's viewpoints. The participant's viewpoint is an operator's viewpoint; the observer's (or onlooker's) viewpoint, is that of a commentator. Developing science (geometrical optics) and interacting with another tradition, are historical examples of major missions from two different domains. Where the operator's viewpoint is interested with what to do and how; the commentator's viewpoint is interested with what and how it is (was) done, in terms of the resources used, the methods employed and the results obtained etc.

The addition of "regulative" to "commentator's" has to be explained. It is added because the capability to describe in detail, from an onlooker's viewpoint, i.e., to represent, or more precisely, to model prospectively the situation, the actions and the problems, is exactly what is required for regulation. This claim is rigorously proved by Conant and Ashby (1970). A theorem proved by them states that any regulator of a dynamic system that is maximally both successful and simple must be isomorphic with the system being regulated. Or in the phrasing of the title of this paper; "Every good regulator of a system must be a model of that system."[6] The major difference between the commentator and the regulator is that the regulator is interested in on-going processes which still can be changed, and in keeping them within prescribed tolerances. The commentator is interested in the way these processes were, are, or are going to be. What is cognitively common to both is the need to model the situation which is of interest to them. Such a model is, of course, only a necessary condition for the exercise of control. To regulate, the regulator needs to be powerful enough with respect to the regulated system in its environment, in addition to being a good enough model of that system.

Algorithms can do for some operator's questions, but as a rule a commentator's question needs some heuristics, if only in addition to some algorithms. For example, some inventory control[7] problems can be handled by algorithms. Indeed there are today computerized warehouses which are operated by some computerized algorithms. Yet, there are no algorithms for writing history,[8] preparing intelligence estimates[9] or solving meta-philosophical problems.[10] A question which calls for an application of an algorithm is not about the suitability of the conceptual framework (used to answer some problem), nor is it about describing the full range of details of some interaction. It is not the description from without of how a major mission is undertaken. Rather, it is a determination (by computation) of some exact quantitative values. It can be used to determine hat to do next, and how best to do it provided that the problem is fully specified (see above, (a), (b) and (c)). When what is at stake is providing a description of the ways a major mission is undertaken, in terms of the resources used, the methods employed, and the results obtained, and especially when some judgments about them are required, then some heuristic is called for. Thus, algorithms are suitable for the operator's viewpoint whose interest is restricted to what to do next questions while heuristics, which are more amenable to ill-formulated problems whose execution is propelled by situation-sensitive judgments which may require appreciation of the situation in toto including the suitability of the very conceptual framework which is used, cohere with the commentator's (regulative) viewpoint.

(e) Systemic level: The distinction between an object level and a meta-level is common in logic, where it applies to languages and language systems (Carnap, 1942). It can easily be extended to systems of various sorts.[11] Given a system S of some sort, symbolic or material, manipulations of relevant inputs to S according to its rules is an object-level, or a first-order, matter of S. Discussions of the ways such a system works, especially concerning the rules of S or the relations between S and its environment and their properties are of second-order nature relative to S.

The performance of an algorithm is an object-level matter. It concerns the manipulations of some inputs according to the rules of the algorithm. On the other hand heuristics may need also second-order, or meta-level considerations, especially where the heuristic needs to judge the success of prior stages in the solution effort, to appreciate the situation, or to evaluate the appropriateness of the framework used in the solution effort. For example, heuristics built according to the "improvement strategy" (Foulds, 1983, pp. 929-930), begins with a solution to the problem under discussion. This solution may have been reached by a different heuristic. This solution is then modified. The procedure contains judgment of improvement on a far-sighted basis. This means that sometimes worsening modifications are accepted if they may "create a situation where worthwhile gains can be made" (p. 930). Judgments of the sort which are required for considerations like this clearly require a meta-level with respect to the method for improving the system.

C: Attitude Towards Errors

(f) Elimination vs. exploitation of errors: A prevalent attitude towards errors is elimination. Errors are considered as useless and damaging mishaps which should be eliminated. This attitude is characteristic of algorithms. A procedure suggested as an algorithm has to stand a straightforward test: either it is an effective method or not. If it is, it will produce a solution for any solvable problem from its task-set of problems in a finite number of steps. There can be no errors in producing the solution when an algorithm is applied to a solvable problem from its task-set of problems. If the suggested procedure produces errors -- i.e., mistaken (relative to the rules of the formal domain to which it is applied) or inferior (relative to preferences over what can be achieved in object domain) end-results, it has to be corrected, improved or "debugged" (as it is called in the computer jargon). Before it is completely debugged it is not an algorithm (for the specific task-set of problems on the specific device(s)). In other words: "an algorithm" like "a solution" is an achievement word. A mistaken solution is not a solution: it is a non-solution which, mistakenly, is thought of as a solution. The same with algorithms. An ineffective procedure is not an algorithm. In other words: (by itself) an algorithm does not produce errors (i,e., non-solution end-results, mistakenly thought of as solutions). Such errors, which can be due only to the implementation, or the performance, of the algorithm, and especially to the "human factor," should be eliminated.

A contrasting attitude towards errors is exploitation. When it is recognized that the capacity to invent new designs (alternatives) is crucial but seriously constrained, then when an error is made, it may be a sheer waste to discard it completely, without extracting the most from it, given that it has already occurred, especially when the costs to produce it are taken into account. For an erroneous result of an attempt to arrive at an appropriate decision may, for example, reveal new facets of the decision situation, lead to a renewed formulation of the problem, or serve as a starting point for another effort when environmental conditions change. Thus, the occurrence of errors may contribute to escaping the trap of over-adjustment by confronting those errors. This confrontation keeps alert the decision making body which has to appreciate the situation in order to realize that the end-results of the solution procedure are mistaken. By this it is possible to learn something about those eventualities referred to in those end-results. In case those eventualities are actualized, the decision making body finds itself facing conditions which have already been discussed and appraised.[12]

Exploitation of errors is the attitude geared to heuristics. For when it is recognized that the heuristic solution procedure does not guarantee success,[13] then the occurrence of non-solutions as end-results can be expected. They occur not because of poor implementation but they are inherent in the procedure itself. To discard them altogether is a waste. They still can serve as "progenitors of change," to borrow Stafford Beer's phrase (1979, p. 62).

D: **Time Duration**

(g) Instants or extensions: The time duration of the performance of an algorithm depends on the properties of the machine, i.e., the medium of computation, which is used to run the algorithm. It is quite clear that this duration is a cost. Efforts are made to shorten it, and with the advance of new and more powerful computers it actually shrinks. The minimal time duration reflects the limiting properties of the machine. Thus, all material computers (a kind of machine for running algorithms) are subject to physical (and chemical) constraints (e.g., concerning the velocity of light). But when algorithms are abstracted from the machines used to run them, these constraints are seen as accidental. They have nothing to do with the algorithms per se. These limits express contingencies of the medium of computation rather than some characteristics of algorithms. The algorithms remain invariant under such abstraction. In the abstract, the performance of an algorithm is revealed to be an instantaneous computational event. In other words; an algorithm lacks any inherent duration in time.

Heuristics, in contradistinction to algorithms, may have an inherent duration in time. Some heuristics include among their procedures processes which occur in the material (object) domain, and not only in some formal symbolic domain. It may be trials of various sorts and recording the response from the environment. These serve as a basis for judgment concerning the progress of the heuristic procedure, or its termination and the issue of a decision. Also, judgments of the appropriateness of models on the basis of comparisons between behavior according to the model and the actual processes unfolding in the material domain depend on feedback loops which have their inherent time-lags. These cannot be abstracted without altering the heuristic procedure, indeed, without crippling it. Moreover, some heuristics include manipulation of the material domain in general and organizational elements, in particular, in their repertoire of processing options. Such processes in the material domain have a time extension which cannot be abstracted similarly to algorithms. The crucial difference in this respect between algorithms and heuristics, was already discussed above (point b (ii)). It is that algorithms operate only in the symbolic domain while heuristics operate also in the material domain. Therefore they cannot be abstracted from it. Where algorithms depends only on logic (including mathematics), heuristics, or at least some of them, depends also on the "physics" of the situation.[14]

II: Regarding Decisions

E: Decision Problem

(h) Given or self-set: Algorithms can be developed or applied only to given problems. When there is not a given problem, there is no sense to having an effective method for its solution. This is immediate. Some heuristics resemble algorithms in this respect. A heuristic for the traveling salesman problem (see 5.2.1 above) can only be used when a specified problem is given which has the same structure as the travelling salesman problem.

Nevertheless, some heuristics do not require that their problems should be given in advance. They can be triggered off by a vague recognition, or charge, that "something is wrong" or that "there is some problem somewhere in the (conceptual or organizational) system". Such heuristics look beyond the apparent symptoms for the underlying problems. Diagnosis is taken to precede prescription. They are equipped with the capability to probe and settle their problems for themselves. Even when a problem formulation is given, they can suspect it and search for the right problem to be addressed. The SACBS discussed above, provides an example.

F: Direction

(i) Given-goals or self-direction: Algorithms require that the goals (for the contemplated decision) should be given. They should be given in a way which is at least amenable to reformulation in unequivocal mathematical terms. Otherwise no objective function (as it is called among operations researchers) can be stated. (Examples for such functions are: total costs of a system; time to complete mission; marginal benefits minus costs etc.) Attempting to apply an algorithm when no goals are given is like commanding a machine to compute without telling it what to compute.

Some heuristics among those used in operations research are similar to algorithms in this respect. They require given goals (e.g., the heuristic for the travelling salesman problem). Others are quite different in that they direct themselves. No specific goal needs to be given let alone in a way which is amenable to mathematical treatment. Only a vague major mission has to be known, and the heuristic will direct itself. One of the interim outputs of the heuristic may be a goal or a set of goals to be followed later.

Again the SACBS provides an example where the setting of goals -- developing a suitable strategic bombing force having a second strike capability -- became possible only after the unfolding of the heuristic taken by the researchers working on the SACBS.

G: The Adopted Course of Action

(j) Among the givens or newly designed: An algorithm can only select a course of action from those given in the formulation of the problem. There are two ways by which courses of action can be given: either they are given explicitly, as when a description of each of the available courses of action is explicitly stated, or they are given parametrically, as when each alternative is some combination of values of parameters from several dimensions, and only the dimensions are specified. An example of the second sort is the constrained maxima methods of micro-economics where each course of action (a bundle of commodities) is a member of the positive section of an n-dimensional Euclidean space and the selection of a course of action is subject to some constraints (e.g., budget constraints) and preferences (indifference map). The alternatives are given by the specification of the various dimensions of the n-dimensional Euclidean space (Henderson and Quandt, 1958).

Some heuristics can be put to use only if the alternatives are given, at least parametrically. Again the heuristics for the travelling salesman problem serve as an example.[15] But there are other heuristi.s which lead to the adoption of a course of action which was not given or indicated in any way at the start of the heuristic procedure. Those heuristics which serve not only to select alternatives but also to design them. Two examples illustrate this sort of heuristic. The first is the mountain climbing heuristic mentioned above (b (ii)). The only givens are the urge to reach the top, and the conic shape of the mountain. The alternatives are possible routes to the top. But none of them is given. They even cannot be perceived in advance, because the mountain is engulfed by clouds. Only by the unfolding of the heuristic an alternative is produced. (The "goal," i.e., the location of the top, is also produced by the unfolding of the heuristic.) The adopted course of action, which is this route produced by the heuristic, or an improvement on it, is not among the givens of the problem. The second example is the SACBS, where the adopted course of action, viz, locating the operating bases of SAC well within the boundaries of the U.S.A. and maintaining overseas bases for ground refueling only, was clearly not among the givens of the problem. Indeed, it was in a direct contrast with the given problem.

H: Criteria

(k) Extreme value or robustness: The typical kind of criteria used to select an alternative when decision problems are treated by algorithms is the extremization of some index or function. Sometimes this extremization is made subject to some constraints, but not always. Maximization of expected utility, or the minimization of total costs, are examples of unconstrained criteria. Minimization of costs subject to providing some specified level of performance, or the maximization of satisfactions subject to a given budget are examples of constrained criteria. Texts of operations research provide a wealth of criteria with their associated algorithms.[16]

Providing extreme value is what cannot be guaranteed by the use of heuristics. Yet, for many heuristics -- especially those designed to simplify and ease the burden of computations -- being relatively close to such an extreme value, is among their required features. But for many heuristics this cannot be required. Indeed, for that heuristic in use which handled the SACBS this could not even make sense. The criterion used there was robustness of the selected course of action under some spectrum of contingencies judged to be relevant. Such a criteria cannot be reformulated in terms of extremization of any index.[17] Nor can it be reformulated as a combination of some extremizations. For what it tries to achieve is a broad enough stability of the acceptability of the outcomes (of the adoption of a course of action) under that spectrum of contingencies judged to be relevant. Neither the determination of the spectrum, nor the determination of the level of acceptability (or aspiration) can be made solely in terms of minimization or maximization of any index. For it inherently involves judgments which are not anything like extremization of some value. The considerations brought above (4.2.5) in connection with the SACBS illustrate this point.

I: The Level of the Typical Decision

(1) Tactics or strategy: Among the most common distinctions between classes of decisions is the one between tactical and strategic decisions. Although originating in the military context this distinction was borrowed and elaborated in the management context (Ansoff, 1969; Bracker, 1980; Sutherland, 1977). The distinction is sometimes multiplied, e.g., Sutherland (1977, p. 7). For our purposes it suffices to distinguish between strategic and non-strategic decisions which are lumped together under the label "tactical". The distinction is usually characterized by a host of attributes, some of them behavioral

(like pricing of particular products vs. diversification of investments) and some environmental (like risk and uncertainty vs. ignorance); some organizational (like decentralized vs. centralized process) and some cognitive (like optimization vs. goal-setting). The characterization suggested here concentrates mainly on cognitive factors.

Objectives are given for tactical decisions, but are open and in need of being set in (at least some) strategic decisions. The only given in this kind of decision is some broad and vague major mission, which has to be analyzed and interpreted in the particular context (the environment of the particular strategic decision). While resources are fixed in tactical decisions, they have to be developed and allocated in strategic ones.[18] The kind of criteria used in tactical decisions is efficiency in the use of the fixed resources for the attainment of the given objectives. In strategic decisions the kind of criteria is effectiveness in furthering the major mission. There are authors, e.g., Mintzberg et. al. (1976) which characterize strategic decisions simply as those

> "important in terms of the actions taken, the resources committed, or the precedents set" (p. 246).

Algorithms fit tactical decisions; heuristics are needed for the strategic ones (Sutherland, 1977, p. 7). For the efficiency criteria used in tactical decisions can be formulated as maximization of outputs subject to fixed inputs, or the minimization of inputs subject to some required level of outputs, or the minimization of costs.[19]

5.1.3 **Practices:** Practices are claimed to compose the ontology of CSR. An analysis of practice is first introduced (5.1.3.1) and then (5.1.3.2) exemplified in the context of bridge construction. It is claimed that any practice can be analysed into these structural units suggested here (5.1.3.3). Practices may differ in the relative weights given to those structural units at some particular point in time, and, especially, in the course of their development in time.

5.1.3.1 **Practice analyzed:** Practices like composing music, painting pictures, stage production, selecting people for public office, keeping order and punishing criminals, worship, organizing society (Feyerabend, 1978, p. 26), or bridge construction, law, public accountancy and policy-making, can be analyzed as follows:

(i) The core synchronic component of a practice, called here 'conduct' is composed of three phases; deliberation, action, and product. Every practice is a practice of doing something -- playing a musical piece, painting a painting, producing a theatre show, keeping law and order, building a bridge, or executing a policy. That something is the product phase. The making of that something is the action phase. Actions, if not erratically or accidentally taken, are preceded or accompanied by some cogitations about the action -- the what is it, why, what for, and the how and when of it. These constitute the deliberation phase.

(ii) The basic synchronic units of a practice are cycles of conducts (or tokens of a conduct) and their results. Products, like those mentioned above, are not usually made for themselves. They are intended to have some desired impacts. If the results are not what they were supposed to be the actions may be changed, following or simultaneously with some deliberations, so that the product is changed in the hope that the results will be satisfying.

(iii) Over and above the core component there may be one or both of two superstructure components. These are institutions and traditions, which may and usually do appear to accompany conducts. They range from customs and habits to mandatory regulations and statutory organs.

5.1.3.2 Bridge construction as a practice: Bridges were constructed already in the ancient world. Herodotus tells of a bridge constructed in Babylon over the Euphrates more than four thousand years ago by diverting the river and building the bridge over the dry riverbed. In the Roman empire the practice of building bridges advanced by the utilization of the arch, and the innovation of mortar cement. About two thousand years ago, Cauis Julius Lacer built a mighty bridge over the Tagus at Alcantara, Spain, for the emperor Trajan. The bridge has 30 meter wide arches, and its roadway is 52 meters above the river level. The origin of the practice of building bridges is not known.

A prevailing opinion is that the first bridges used were natural bridges of rock over rivers. The first man made bridges are supposed to be imitations of those natural bridges (Britannica, 1974, pp. 174-191).

This veteran practice can be analysed using the scheme suggested above as follows: The product is simply bridges. These may be made from ropes or wood, from stones or concrete, from steel or from whatever materials which are fit and available! The action is all the actual work that is done on the site of the would-be bridge, in order to construct it, by men and by machines, and supporting operations, like logistics and finance, which take place somewhere else. The deliberations are the planning and design of the bridge, both before and during the action phase. Also included in it is the monitoring of the results -- in terms of the contribution of the bridge to the transportation network in which it is a component. Cycles of this conduct and the ensuing results may lead to improvements in deliberation, in general and particular cases, to amendments of action, and to progress in product. They may also lead to the emergence of institutions and traditions such as licensing qualified engineers and architects, or the mandatory procedures of authorizing plans and design, or the use of some materials and some shapes for the construction of bridges at places recognized (by tradition or deliberation) as suitable for the construction.

5.1.3.3 The claim about the composition of practice should be taken methodologically: The claim that any practice can be analyzed in terms of the above mentioned factors should be taken methodologically and not metaphysically. It should be taken as a suggestion for a set of useful categories to be used regarding practices. It is a combination of a conceptual analysis of the concept of doing, together with some broad empirical generalizations. Thus, doing is doing of something, which is the product. Similarly, at least in the more complex and organized kinds of doings -- those usually called practices -- deliberations of some sort accompany the doings. The broad empirical generalizations are that institutions and traditions emerge that accompany the cycles of conducts and results. Those broad generalizations can hardly been attacked. Nevertheless, the argument about practices as constituting the ontology of CSR does not depend on them. It needs only the cycles of conduct -- with the three phases-- and results.

It may be noted that different practices may differ in the relative importance given to the various phases of conduct, the sensitivity to results, the kinds of institutions and traditions and the ways they operate and exert their influences. They may also differ in the ways the various phases of their respective conducts are carried out.

5.1.3.4 **Theorizing practices**: Of special importance is the difference in the courses of development of different practices. One of the important factors in the development of a practice is the development of the knowledge pertaining to it. Theoretization is usually a late comer, at least for the modern veteran practices. In such practices theoretization occurs when there is a significant amount of experience, common knowledge and tradition (and maybe also some institutions) relating to that practice. The course of development of a practice may be influenced by the order by which the three phases are theorized. This order may be accidental from the perspective of the particular practice. For the driving force behind it is usually the availability of relevant theories. This availability may be determined to a large degree by factors external to the particular practice. Bridge construction and policy making illustrate this point.

The order of the phases of bridge construction by which theoretization was introduced into this practice is: product, action, deliberation. In policy making the order is: some fragments of action, deliberation. There is virtually no theoretization of the product phase (see Chapter 3 above). The product of bridge construction was theorized following the advance of mechanics. Phenomenological modes of description of bridges were substituted by that talk about weights (masses), force, moments etc. This transformation of modes of description enabled design of bridges to specifications of their intended results. By this the construction of longer and broader bridges becomes possible, together with ensuring required margins of safety and economy. The action phase becomes imbued with theory with the advance of engineering tools, methods and machines. The last phase of bridge construction into which some theoretization was introduced is deliberation. The appearance of theories of decision making, planning, problem solving, operations research and systems analysis brought a host of approaches and methods of deliberation pertaining to bridge construction. These have culminated in transportation systems analysis (Manheim, 1979).

In policy making attempts at theoretization were directed first at the action phase. Political scientists concentrated their efforts mainly on power struggles as the force molding policies (Morgenthau, 1947). This attempt produced descriptions, but these could not serve as a basic for normative theory. The attempts to theorize the deliberation phase of policy making (e.g., Dror, 1968, 1983; Dunn, 1981) are intended to serve as (at least as a basis for) normative theories of policy making deliberations (and to some extent also of the actions). But there is no theoretization of the product. As argued above in Chapter 3 this situation is not accidental. The attempts to theorize policy making deliberation are moulded after decision making theories. In particular, the same R-concept is used. It is a result of this R-concept (i.e., some version of RVR) that theoretization of the product is virtually prohibited (Chapter 3). What is required is a consonant theoretizaton of the product and the deliberations (and the actions).

5.1.4 CFR: Context Free Rationality is an extreme R-concept. Yet it is quite a common one, and if not explicitly, then it is so by way of some presuppositions or implications. It can be identified in the writings of philosophers, decision theorists, and policy scientists. CFR is first introduced and characterized (5.1.4.1) and then (5.1.4.2) its relation to RVR is discussed.

5.1.4.1 CFR Characterized: CFR can be characterized as an R-concept such that:

(i) its ontology (domain of intended applicability) is separable instrumental choices,

(ii) its m. :hodology is algorithmic and,

(iii) its orientation is analytic (decomposing).

Of these three factors the last two hardly need additional explanations. The algorithmic methodology is the claim that the proper method for an R-concept is algorithmic. The notion of an algorithm and its relationship to R-concept is discussed above. The analytic orientation is also quite familiar. It is discussed above (1.2.1) in connection with RVR. In short, CFR takes any problem as analyzable to component problems which can be treated algorithmically. The solution to the original problem is supposed to be some combination of the solutions to the component problems.[20]

The factor that deserves further discussion is the separability of instrumental choices. The conception of instrumental choices relies heavily on the idea of the consequences of a choice. In a nutshell the consequences are "anything that may happen to the person" [which takes the decision] (Savage, 1972, p. 13; see also Fishburn, 1981, p. 141). But, borrowing an example from Tribe (1973) we have to contend that in some cases, a change in the agent which takes the decision is among the consequences. Such is the decision to authorize new technologies, like genetic engineering, which affect the agent himself. In a situation like this, where the agent is transformed by the consequences of a decision, there is no sense to evaluating the consequences according to the agent's preference (as is required by decision theory). Evaluating consequences (and the decisions leading to them) by preferences makes sense only when the agent remains invariant under the occurrence of various possible consequences. This agent-consequences separability is one ingredient of the separability of instrumental choices. The other two are the identifiability of a well-defined set of consequences and the absence of joint effects between different decisions. If there is not a well defined and identifiable set of consequences no instrumental choice can be made. For the evaluation is how much does the selection of a means (an alternative) further the (relative) achievement of ends (preferred consequences)? Similarly, if there are joint effects between some decisions, none of them can be made on its own as an instrumental choice. For the set of consequences of each is not identifiable as well-defined (because it is not stable). They must be considered together, if at all. Thus, only if the decision is separable in the three senses -- agent-consequence separability, separability in the time direction (without which no well-defined set of consequences can be identified, because the chain of consequences may continue in time indefinitely), and separability in the horizontal direction (the absence of joint effects) -- it can be treated as an instrumental choice).

5.1.4.2 **CFR and RVR**: As it is said above, CFR is an extreme version of RVR. It states explicitly what is sometimes left implicit when RVR is put into use. This implicitness opens the gate to relaxations and compromises. RVR was characterized above as instrumental, formal and analytic. At the extreme, or ultimately, an instrumental choice is separable; at the extreme a formal approach to choice is algorithmic; at the extreme the content of this R-concept is fully formalized. In real cases of applications these are sometimes only approximated. Thus, CFR is an idealization of RVR.

5.1.5 CSR: Context Sensitive Rationality is also an extreme R-concept. As a first approximation it can be said to be an antithesis to CFR. It occupies the other extreme position on a spectrum of R-concepts. In 5.1.6 their relationship is probed in some depth. But first CSR is characterized (5.1.5.1). Dimensions of the sensitivity to the context are discussed in (5.1.5.4).

5.1.5.1 **CSR Characterized:** CSR can be characterized as an R-concept such that:

(i) its ontology (domain of intended application) is practices,

(ii) its methodology is heuristic, and

(iii) its orientation is integrative and synergistic.

Factors (i) and (ii) are discussed extensively (and separately) above. (iii) can be understood as being the opposite of (iii) of CFR. Yet some discussion of synergistic effects of these three elements of CSR is needed.

When that which is deliberated upon in the context of a decision is not a separable choice, but rather a practice, composed from cycles of conducts -- i.e., deliberation, action, and product -- and their results, then an analytic orientation is not suitable. For the analytic approach may decompose the practice in such a way that the very sense of practice -- cycles of the three phases of deliberation, action, product and results, occurring within an institutional setting and within some tradition -- is lost. Also, a practice calls for a treatment which is not algorithmic. Thus, even in a rather well understood practice, e.g., bridge construction, algorithmic reasoning is not sufficient. For though some stages of bridge construction-- like calculating its width as a function of estimated traffic or designing its physical characteristics on the basis of data like the estimated traffic demand, strength of materials and designs, and movements of the soil etc. -- can be done algorithmically, not all the stages are like this. Judgments have to made about the goals that the planned bridge has to accomplish within some reasonably wide segment of the transportation network of the relevant region, and the boundaries of this segment and its goals within some wider and broader socio-technical-geographical system. These judgments and others cannot be made algorithmically (as argued above).[21]

5.1.5.2 **CSR and Self-Referring Practices**: If these considerations hold for practices in general, they hold <u>a fortiori</u> for self-referring practices. Some practices, though not all of them are self-referring. The practice of bridge construction, for example, cannot be applied to itself. Bridge construction directed towards itself is not bridge construction. On the other hand, philosophizing about philosophizing is indeed philosophizing. Its product is philosophy. (Sometimes this kind of philosophy is called meta-philosophy; e.g., Hooker, 1975a.) For self-referring practices the argument given above holds even more strongly. Where there is self-referrence there is also meta-level considerations. These meta-level considerations regarding a practice relies on judgments which are inherently non-algorithmic. Using philosophizing as a paradigm of self-referring practices it can be said that neither the province nor the methods nor the results of philosophizing can be decided upon in advance by using algorithms exclusively as the reasoning method of philosophizing (especially while philosophizing about philosophizing). Some of these are rather undecideable in the formal sense, while others rely inherently on judgments of various sorts. Otherwise philosophizing would have probably exhausted itself a long time ago. It is philosophizing and trying to live (and not only to think) in consonance with philosophical conclusions that contributes -- together with other factors which inherently requires time extended processes, like trying various forms of government, developing science and technology -- to the appearance of new philosophical problems and to the rejection of old philosophical solutions. Algorithms which try to solve all those problems formally (i.e., symbolically and in advance) must miss all the factors which depend on experience gained in the time extended process of the real (object) system. They are, therefore not adoptable for practices in general, and for self-referring practices in particular. On the other hand some heuristics are capable of taking care of the presence of meta-level and self-referring considerations (as discussed 5.1.2.3 (e)).

5.1.5.3 CSR, Practices and the Integrative-Synergistic Orientation: A practice has an integrative nature. It can improve (itself) not only by improving components (as is done in the analytic orientation) but also, and more importantly by improving on the purposes served by the practice. This can be done by directing the practice to higher levels and broader purposes. The transformation of the perspective of bridge construction from finding solutions to local point problems to the contribution achievable by the proposed bridge to some regional (or metropolitan) transportation network, and to the containing social-political system, is an example. This integrative aspect of practice can be accounted for by some heuristics, as it depends on a meta-level capability for self-direction. As is discussed above (5.1.2.3) some heuristics have this capability.

The self-directing quality of some practices can also be seen in another development within bridge construction. Once freed (by the gradual theoretization) of the bonds of habit and custom, bridge construction became virtually self-directing. The only external intervention is that of those state institutions which affect the institutional setting and functioning of bridge construction. Some heuristics can handle this self-directing aspect of those practices.

5.1.5.4 Dimensions of the Sensitivity to the Context: The units of the domain of CFR, i.e., separable instrumental choices, are fully determined by the conceptual framework. It is the particular theory of choice, if not the R-concept itself, which determines what counts as an instrumental choice. The theory specifies, for example, what counts as alternatives, goals, preferences, criteria, etc. A choice is specified when the alternatives are given, as well as a criterion for the selection of an alternative, which expresses the goals for performances. As discussed in Chapter 1, the ontological role of an R-concept of the RVR variety, fully determines the domain of applicability, or the ontology of that R-concept.

The situation is different with respect to CSR. What is to count as a practice is indeed characterized to some degree by CSR, but not completely. It is not for the theory alone, in this case the particular R-concept, viz, CSR, to determine the boundaries of various practices, or the degree of resolution of the discussion of practices, i.e., the degree of specifity of the terms used. The R-concept alone cannot settle these matters; the actual practice itself, in general, and the specific situation, in particular, are required to do it. Thus, the degree of resolution which is found to be appropriate for the discussion of some problem, is rather arbitrary, from the concept's perspective. Whereas CFR takes the degree of resolution of the given (alternatives, criteria, etc.) and works with it as given, CSR has to settle the resolution for itself. Supplementation from the situation[22] is required for this task, over and above the concept itself. Similarly with respect to the boundaries of the practice under discussion. The concept alone cannot determine the boundaries of painting pictures, selecting people for office, or bridge construction. The actual context is required to supplement these determinations.

The sensitivity to the context is not restricted to the ontological component of CSR. It is rooted also in the methodological and orientational components. These components, as can be seen in the discussion above, are saturated with judgments. These judgments require supplementation from the context; they cannot be made by reference to the concept alone.

The sensitivity to the context has several dimensions. Some of these are classified and listed below. Not all of the following dimensions are relevant in each case where CSR has to be applied. The list is only a first attempt; it is rather tentative then definitive.

I. Characteristic of the Problem Space

(1) Features of the domain

(i) The structure and functioning of the domain--painting pictures is different from selecting people to office, and those two from bridge construction; the differences may affect the appropriateness of some particular R-concept (from the CSR variety).

(ii) The structure and functioning of each of the three phases of conduct -- deliberation, action, product--their relative importance and their interrelations.

(iii) The sensitivity to results

-- The appropriate degree of sensitivity may vary between different practices, and over time within the same practice.

(iv) The structure and functioning of the accompanying institutions and traditions

-- a trivial example; where everything is determined by tradition, there is no use to deliberation.

-- acting within existing institutions and traditions, or acting to change them.

(2) Ethical

(i) Moral considerations

-- to participate or not in a practice

-- to participate in order to change

-- taking into consideration rights and claims of various interested parties

(3) Intellectual

(i) Identification of the right problem

(ii) The function of the decision

-- constructive, strategic, administrative, operational

(iii) Self-determination or external guidance

(iv) Frequency of the decision

(v) Deterministic or not so

(vi) Goals

-- given or not

-- single or multiple

-- coherent or conflicting

II. Scope of the Problem

(i) Separable problem or interacting problems

(ii) Material consideration

-- how to land a man on the moon is of greater scope then constructing some bridge

(iii) Information required

-- variety

-- resolution

-- quantity

-- processing

(iv) Consequence-wise

-- like critical financial outcomes vs. marginal ones

III. The Level of the Deliberating Unit

-- within an organizational hierarchy

-- the level of the organization within the national system

-- a higher level may require distinctive extra considerations

IV. The Scope of the Deliberating Unit

(i) the size of the organization which exercise the practice

(ii) the size of the deliberating unit (which may be only some part of that organization)

(iii) the capabilities of the deliberating unit

-- creativeness

-- experiences

-- knowledge

-- expertise

-- information handling and processing

-- organizational flexibility

V. Stage in the Life-Cycle of the Problem (Area)

-- incipient, novice, growing, mature, declining

Differences between situations which can be captured by this set of dimensions and parameters and by similar ones can influence the appropriateness of R-concepts for these situations.

5.1.5.5 **CSR Recapitulated:** The meaning of CSR tends to get lost in the multitude of dimensions and considerations of its sensitivity to the context. Therefore, a short restatement of its main thrust may be helpful.

According to CSR:

(i) it is not true that one and the same R-concept is relevant and applicable to all situations.

(ii) Moreover, the situations towards which CSR is applicable are those dealing with practices.

(iii) The particular CSR-concept which is relevant to some situation is dependent upon various dimensions of the situation, some of which are listed above.

As a result of the multi-faced sensitivity to the context and the ensuing manifold of R-concepts it is more coherent to speak of CSR as a generic R-concept which may be exemplified by different CSR-instances in different situations. It can also be said that in different contexts different CSR-instances may be appropriate.

Understanding an R-concept requires understanding its normative power. It can be said that appropriateness of a CSR concept (or instance) is the vehicle by which the normative power of CSR is expressed. But what is that normative power? The following is a first pass at answering this question.

To gain a perspective we look first at CFR. The normative power of CFR is that of coherence. A choice of any alternative but that given by algorithm used as the solution for the problem is a violation of coherence. Coherence is required among the agent's preferences and between the alternatives chosen and his preferences (see also 1.2.2 above for the normative power of decision theory). This is an expression of the quasi-logical nature of CFR (and RVR as an instance of it).

With CSR the situation is different. Practices are much more complicated units than separate instrumental choices. The last can be assessed against some given preferences. The degrees of freedom inherent in practices outnumber those found in separable instrumental choices. The first can (and should) direct themselves, the latter not. Thus, the first cannot be assessed against given preferences while the latter can. Moreover, because of the self-directing capability and the multi-faced sensitivity to the context, nothing about a practice can be regarded as given in any stable sense. Where this is lacking quasi-logicality is out of question. For it requires an anchor with which the rest is compared in order to determine whether some quasi-logical relation holds or not.

If quasi-logicality (not to say logicality itself) is out of question, whence the normative power of CSR? To answer this question we first look at CSR from an observer's viewpoint and try to understand what does CSR do, or better, what kind of effect has the use of CSR? The use of CSR is seen as an effort to utilize more fully the potential for direction and control of a practice. Thus in the SACBS, our paradigm of CSR, the researchers at RAND could have recommended, following some standard economic and logistic calculations, one of the alternatives given with the original problem sent to them by USAF. Had they done this, no one who subscribe to CFR (or RVR) could have attacked them as doing an inferior job of consultancy. But they, as it is seen from their actions, were not committed to RVR. What was gained by their maneuver was a higher degree of utilization, or exhaustion, of the potential for directing and controlling the practice of military planning (or policy analysis) they were engaged in. Had not they challenge the original problem the fact that a larger potential for directing and controlling the practice was available may have remained unknown, at least for sometime But from our vantage, observer's viewpoint, what matters is that, indeed, the potential was there. The (implicit) use of CSR by the RAND team increased the exhaustion of that potential. With this we have a bench-mark for locating the normative power of CSR stems from its role in converting potential for direction and control of a practice into actuality. In particular, it is located in its

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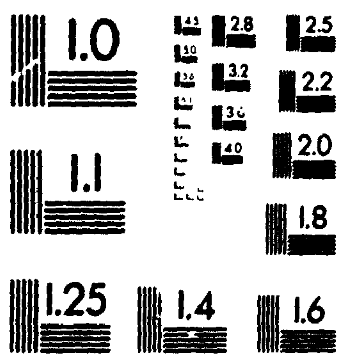

contribution to the exhaustion of this potential.

The exhaustion of some available potential of this sort is one way for increasing the actual amount of direction and control of a practice. Another way is the increase of that potential itself. Thus, two orthogonal[23] efforts can be discerned concerning this potential. The first is a present-oriented (or ontogenetic) effort which strives to exhaust the available potential for direction and control. The second is a future-oriented (or phylogenetic) effort which strives to enlarge this potential over time.[24]

Having said that we are still short of grasping the peculiar character of the normativity of CSR. For the exhaustion of available potential and the secular increase of the potential depend in a peculiar way on the contexts attended to. Because of its context sensitive nature the application of CSR cannot be done by concentrating on the R-concept alone, the context should be studied, assessed and taken into account in order that the particular instance of CSR which is appropriate will be called forth to fulfill its role in the exhaustion of the potential for direction and control of the practice. This means that rationality is not coded completely and exclusively into the R-concept. The concept requires so to say, supplementation from the context, or the environment.[25] Only when this supplementation from the context is absorbed into the concept, can the concept exercise its role in directing and controlling the practice within that very context. Without the required supplementation from the context the concept may be lacking in normative power.

But receiving supplementation from the environment and exercising direction and control call for self-reference and self-direction. Otherwise neither the need nor the amount of these can be determined. But these self-reference and self-direction requires a meta-level from whence to be conducted, which is judged to be suitable for this task. Moreover, all this pattern of relationships has to be judged appropriate, else normative power is lost. For there is no sense to ascribe normative power to a pattern of relationships which is bound to lead to failures. But the concept by and of itself cannot serve to determine whether this pattern of relationships as a whole leads to failures. This pattern has to be judged by matching itself with the results of the practice within the context.

To sum up this first attempt at characterizing the normativity of CSR the following can be said: The appropriateness of CSR concept (or an instance of CSR) is the vehicle by which the normative power of CSR is expressed. The sense of this appropriateness is that this particular concept expresses that possible intervention of human reason with the particular practice by which human reason may exhaust its potential for directing and controlling that practice, on the one hand, and persistently striving to enlarge this potential, on the other, by receiving required supplementation from the context. This is achieved by self-reference and self-direction taken from a suitable meta-level and judged to be like this, where all this pattern of relationship is judged by matching itself with the results of the practice.

5.1.6 Relations between CFR and CSR: As a first approximation the relation between CFR and CSR can be seen as two extreme poles of a spectrum of R-concepts. Various R-concepts can be located between them. For example, an R-concept which is instrumental but uses heuristics which take the characteristics of a problem as given is located somewhere between CFR and CSR. It differs from CFR by not demanding algorithmic methods (and the excessive cognitive capacities which are required to apply them). It differs from CSR by not being self-directing, and thus also not being integrative-synergistic.

When the relation between CFR and CSR is probed further an interesting pattern is exposed. As a concept CFR seems to be self-sufficient. Indeed, some versions of CFR are known for their elegance. But as a basis for practical applications CFR is not sufficient. For example Linear Programming which is among the better known CFR-based models of decisions,[26] can be applied only because it has already been judged to be an appropriate model for some decision problems. To judge it to be like this, CFR rationality is not sufficient. No model whose core is just an algorithm for a separable instrumental choice can be used to issue such a judgment. What is required for that judgment is to compare that model and the desirability of actual decisions made with it with the desirability of other possible decisions which can be made without this model, on the one hand, and a critical evaluation of the algorithmic model on the other hand. Only after those tasks are done with favorable results can the model be judged as appropriate and only then can it be used without additional considerations for problems with structures similar to that postulated in the model. But these judgments can only be made from a meta-level which enables reference to the Linear Programming model and to the actual reality of the decisions. The rationality of such a judgment which is necessary as the basis for the actual use of CFR models, is clearly not from the CFR type, but of the CSR type. Thus, we arrive at a somewhat surprising result. Ultimately CSR is needed. CSR can be self-sufficient, because of its capability for self-directing, on the one hand, and its sensitivity to results on the other. CFR is not self-sufficient. Only after it has been established, with the necessary use of CSR rationality, that it is applicable to some set of problems, it can be actually applied.

5.2 CSR is Adequate for Policy Theories

Indeed, CSR is adequate for policy theories. To establish that CSR is an R-concept which is adequate for policy theories, three arguments are presented. The first (5.2.1) argues that CSR is indeed an R-concept. It uses the triple distinction (made in 4.3.4) between an R-concept, its related method (or methods) and its domain(s). This together with the characterization of the relations between them can be seen as a contribution to the theory of rationality. Of special interest is the argument that the content of the appropriateness--i.e., the normative force -- of a method and its R-concept is inherently (even ontologically) dependent on states of knowledge and thus cannot be foretold.

A question which remained open from the end of Chapter 4 is the identification of that R-concept which can capture the rationality of

SCABS. Granted that CSR is an R-concept, it is argued (5.2.2) that indeed it is CSR that does it. The power of its heuristics -- some of them self-directing and objects (and not only symbols) processing-- enables CSR to capture the rationality of the SACBS.

It remains to show that CSR enables a characterization of policies. Based on the self-referring property of policy making as a practice (meta-policy is a policy), a recursiveness property is identified for products of self-referring practices. With the help of this property CSR is shown to enable conceptualization of policies-- as products of policy making -- which retains the recursiveness property. CSR can do it because of the self-referring property of (some of) its heuristics. To show that the set of such conceptualizations is not empty, an example is presented without any intention to defend it. According to it policies are seen as identities of the systems which determine their own identities.

5.2.1 **CSR is an R-concept**: CSR is declared above to be an R-concept with some particular features. But is it so? The argument presented here sheds some light on the time dependent character of the normative power of CSR (its appropriateness). It also illustrates the relationship between CSR, its method and its domain.

5.2.1.1 **A Possible Objection**: If CSR cannot lead to unique and unfailing results, how can it tell the rational from the irrational? If it cannot do it, as it seems, how can it be an R-concept? This is not just an hypothetical objection. It is virtually the objection raised by Siegel (1983) against Brown's view of rationality (1977) (see also Brown (1978)). Brown argues against algorithmic rationality within the philosophy of science. He advocates a conception of rationality in which judgments are crucial. His rebuttal of Siegel's objection is that Siegel's objection has force only if it is assumed that rationality is algorithmic. If this is not assumed, then judgments and only judgments are possible, even if they lack the precision and the infallibility of algorithms.

Maybe this rebuttal is sufficient for Brown's case, but it is not sufficient for CSR. For it may be the case that some judgments are necessary and that nothing stronger than judgments is possible, and yet it is not clear that by this CSR is shown to be an R-concept. For the notion of judgments is rather loose and vague, and CSR has some detailed and definite structure. Perhaps this structure prevents it from being an R-concept?

Prima Facie, a useful way to answer this question is to look at what is appropriately demanded from an R-concept. If CSR satisfies it, then it can be regarded as an R-concept. A second thought shows that it is not that simple. It is a characteristic of most, if not all, of the discussions of rationality that whether explicitly or implicitly it is assumed that there is but one R-concept. This is found also with Brown's discussion. He does not say that there is an algorithmic kind of rationality and another kind which relies on judgments. Brown speaks of the "mistake" of identifying rationality with algorithmic computability (1978, p. 244), as if there is only one kind of rationality which is not algorithmic.[27] If indeed there is but one correct concept of rationality, then to check whether CSR is an R-concept, CSR has to be checked against that set of requirements that the only kind of R-concepts should satisfy. But, as it is argued in detail above (4.3.4) there is a multitude of R-concepts each of which is adequate for some domain. In other words, the adequacy of an R-concept is domain-dependent. When this adequacy is formulated by some list of requirements, these requirements are domain-dependent. (The result that there must be several concepts of rationality, each adequate in some domain, is a corollary of the thesis that no universally applicable concept of rationality is possible, established in Chapter 2). Thus, it would not be surprising if the adequacy requirements for an R-concept in the philosophy of science are different from those for bridge construction, selecting people for office, painting pictures, or presenting mathematical theorems.

In general terms what an R-concept does is that it <u>justifies</u> a method and <u>rationalizes</u> that domain which is <u>systematized</u> by that method. An R-concept makes its domain intelligible; it sketches, at least in broad strokes, a pattern of acceptable explanations.[28] An R-concept justifies a method by subsuming it under itself. That method, which inheres in the interface between the R-concept and its domain, is revealed as an exemplification or a realization of a conception concerning the appropriate conduct in that domain that has already achieved some degree of conceptual refinement. That method organizes that domain -- either in actual material reality, or in a symbolic domain related to it -- in a way which is conducive to a main function, typical of the domain. For example, in mathematics the function may be drawing conclusions from given premises and the systematization is by chains of deduction; in science the function may be explanation and the systematization may be by hypothetical-deductive system (at least for logical-empiricists); in technology the function may be production and the systematization may be by efficiency.[29]

It is clear now that different domains may require different R-concepts and different methods. Practices are a quite complicated kind of domain, for they have been characterized not as simple collections of objects, but rather as structural units, coupled to their environments -- where the results occur -- and carrying superstructures of institutions and traditions. There are practices, such as painting pictures, selecting people for office, etc., bridge construction, or philosophizing. Within a given practice there may occur events and things which are clearly irrational. For example, it is irrational to paint pictures by randomly spilling paints of various colours on a surface which is paint-resistant so that the paint just flows down the drain, and especially if the prevailing tradition is that of realistic pictures, and the painting is part of an examination held by some licensing authority. It is outright irrational to construct a bridge without any deliberations or with materials known to be faulty. So that some concept(s) or rationality makes sense for practices and is (or are) required for them.

If a method is supposed to systematize a domain (which may be a practice) how can the appropriate method for a domain be determined, unless the domain is known at least to that degree which enables the judgment of the appropriateness of the method to the domain? On the other hand, a domain can be known only by its being approached by a method appropriate to it. For example, only after a considerable knowledge of mathematics was gained it did become possible to determine that the deductive method is the method appropriate for it. But those facts of mathematics (theorems) became known only by the (implicit) use of the deductive method. Only by knowing enough of science it is possible to judge whether a proposed method is appropriate or not. But only by using appropriate methods can scientific knowledge be gained. Only by knowing enough about bridge construction can a proposed method be judged as appropriate or not. But only by using appropriate methods can the facts of bridge construction be known (by producing exemplars of well constructed bridges).

We arrive at the result that there is an interlocking circle between the knowledge of a domain and having appropriate methods for that domain. An important corollary is the following thesis:

Thesis: That which is appropriate for methods regarding their domains depends (ontologically) on states of knowledge, and changes (ontologically) in time, with the change in states of knowledge.

From this thesis the following two results are derived;[30]

(1) There is a limit on what can be known in advance regarding some domain, by reliance on abstract concepts and on methods, unless that domain is time-invariant.

(2) What is appropriate for practice cannot be known in advance.

CSR can now be reaffirmed as an R-concept. It can justify some methods -- heuristic and integrative ones -- and it can rationalize some domains ctices. Different heuristic methods emerge at the interface between CSR and the real practices and their issues. These heuristics are subsumed under CSR. CSR sketches patterns of explanation for practices. CSR can justify the deliberation phase of a practice as its appropriate method: it can be sensitive to results, issue judgments; take a meta-level perspective with regard to the practice; establish self-direction, etc. It can do all this and more while its sense of normative force -- i.e., appropriateness -- cannot be determinable in advance. Only from within the growing practice, the content of the appropriate CSR (or the appropriateness of a given CSR instance) is redetermined.

5.2.2 **CSR Captures the Rationality of SACBS**: By now this claim hardly needs any additional argument. The SACBS is a case of practice, whether military planning or policy analysis. The methods of SACBS are heuristic in the sense of CSR. The orientation of SACBS was integrative and synergistic.

That SACBS is a case of practice is immediate. There were three phases of deliberation (conducting the research), action (preparing the reports and persuading the USAF), and product (the change in policy which was implemented). These were coupled to the results during the three phases, which were not in linear succession but rather iterative. It was conducted within some structural institutional setting, which had some impacts on all the phases and the results, and within some traditions, both of RAND, USAF and the scientific community at large.

All the unique characteristics of SACBS mentioned in Chapter 4 can be accounted for by some heuristics. Indeed, SACBS is a paradigm of self-directing practices. The emergence of the novel concept of second strike capability resulted as a synergistic effect of some (rather instrumental) heuristics. The transformation of the problem, the scrutiny of objectives, the design of new alternatives, the criterion of robustness, the use of organizational structure and functioning as part of the method of SACBS, all are heuristics of the sort discussed extensively above.

The discussion of the rationality of SACBS which was begun toward the end of Chapter 4 can now be concluded: CSR captures the rationality of SACBS.

5.2.3 **CSR Enables a Characterization of Policies:** One of the arguments developed earlier was that RVR prevents a characterization or theoretization of policies. It was stated (Chapter 3) that the capability to develop such a characterization is an adequacy requirement for any proposed R-concept for policies. Does CSR enable this required characterization?

Two arguments are introduced to substantiate the claim that CSR enables the required conceptualization of policies. The first shows that the capability to learn from experience is built into CSR. By it CSR is open to external criticism on the basis of negative experience in application. What tends to prevent RVR from having this capability is the unique constellation of its four roles -- the descriptive, normative, epistemological and the constitutive (ontological). Instrumental choices are that which RVR applies to -- according to the ontological role of RVR. A decision should be made by an instrumental choice -- according to its normative role. A theory of rationality should prescribe that decisions are to be made by instrumental choices -- according to its epistemological role. In this constellation, negative experience in applying RVR tends to lack any effect. For the epistemological role -- reinforced with the ontological role-- reaffirms anew that the theory should be an RVR-based theory. Negative experience can only be attributed to the implementation, not to the R-concept. This is shown in detail in Chapter 3. Over and above this in RVR (as in CFR) the R-concept and the method converge on to each other. (Witness the many discussions in the philosophy of science of scientific rationality where what is discussed is plainly scientific method.) Combined with the former difficulty the result is that the method and the ontology copy each other, in the case of RVR.

With CSR the situation is different. The method of CSR (the particular combination of heuristics found appropriate for the particular situation) is rather different from the ontology of CSR (which is practices). Negative experiences in application can be assigned not only to the implementation but also to the particular method, and even to the specific R-concept from the CSR type which justifies a method which is exposed as leading to failures (according to some approved standards of evaluations).

The rate of change of methods (which are related directly to the deliberation and action phases of the practice) is higher than that of the whole practice with its ramified structure. The relevant R-concept (a CSR-instance) changes at an even slower pace than the methods (which are justified by it).

The second argument is directed to support the claim that CSR enables the required conceptualization of policies. It runs as follows:

(i) Policy making is a self-referring practice. This means that policy about policy making is a policy. Indeed some policy scientists, e.g., Gershuny (1978), Krone (1980), following Dror (1968, 1983), claim that "meta-policy making" -- as they call it -- is an essential ingredient of the policy making process.

(ii) If meta-policy making is a policy, then it is an example of the product phase of that practice.

(iii) On the other hand, meta-policy making is a part of the deliberation phase of that product. For it is part of the considerations which lead to the action and product phases of that practice.

(iv) The deliberation phase of a practice is conceptualized according to CSR. For CSR provides in a distilled form the appropriate way to do what is appropriate to do in the deliberation (in order to finally arrive at the product).

(v) Because of (ii) and (iii) above, the conceptualization of the product phase and the conceptualization of the deliberation phase, i.e., CSR, needs to be consonant, or to agree with each other.

(vi) Whatever is the conceptualization of the product phase of policy making, it has to convey the characteristic regularities of the product.

(vii) Therefore, the characteristic regularities of the product phase have to be consonant with CSR.

(viii) The most striking regularity of the product of a self-referring practice, such as policy making is its recursive property. This property is that the product of the self-referring practice, at any cycle of the recursion, is itself a practice which contains a product, which is itself a practice, which contains a product ...

(ix) Therefore, CSR is consonant with the characteristic regularities of policies as products, only if CSR is consonant with the recursiveness property (viii).

(x) But CSR is consonant with the recursiveness property of self-referring practices. The self-referring property of (some of) the heuristics of CSR, enables it to match the recursiveness of the product of a self-referring practice, by adding layers of self-reference in the heuristic of CSR.

(xi) Therefore, CSR enables some characterizations or conceptualizations of policies as products. These are conceptualizations which retain the recursiveness property of self-referring practices.

Whether any one of these conceptualizations is interesting enough for policy theories, this has to be decided upon by policy theorists.

5.3 So What Is CSR?

Words, words, words, but what is CSR? An interim scaffolding is erected in 5.3.1 before we sign-off. It gives what can be given in response to this question. A task which mainly remains in the status of "for future reflection" is the relationship between CSR and various views about rationality propagated by some philosophers. In a condensed form, which indeed deserves some future work of unpacking and providing supporting evidence and arguments, it is claimed that CSR subsumes many of these relatively partial views, and is supported by many others. The question whether the whole story was told here is attended to in 5.3.2.3.

5.3.1 An Interim Scaffolding: So what is CSR? Though so much was said above, the question may appear. A nagging feeling repeats combing; that a solid answer was not provided for this question. But as Aristotle said:

> "it is the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits" (Nicomachean Ethics, Book I, Ch. 3. 1094b, 25-29).

The quest for a solid content of the relevant R-concept is inherited from CFR. As discussed 5.1.5.5 above, it is the mark of CFR that both its substantive content and its normative force can be characterized in general terms. The content of RVR (as a CFR-instance) is the choice of an alternative (from a set of given ones) which maximizes some criterion expressing efficiency in attaining some given goals (or preferences) (see 1.2). The normative force of RVR (and CFR) is that of coherence (1.2 and 5.1.5.5). With CSR the situation is different. Its normative force can be described in general terms, though it cannot be put into a single and short slogan (this is done and seen in 5.1.5.5). The content of CSR on the other hand, cannot be given in solid and general terms. Were such a characterization possible, that R-concept would have been transformed into another one which is not content-sensitive. But as a lesson from both AMTIT (in Ch. 2) and SACBS (in Ch. 4) there has to be a CSR. As a context-sensitive concept the context of CSR cannot be given in solid terms, for it is partially dependent on states of knowledge which cannot be known in advance (5.2.1.1). (Reread here 4.3-4.3.2 and 5.1.5.5.)

Some words can nevertheless be said about the nature of CSR in contrast to CFR. CFR relates to coherence within the preferences of each rational agent, and between his preferences and his actual behavior. It can state some simple and straightforward maxims for rational behavior in terms of a canonical representation of decisions (1.2 and 2.1). In contrast CSR relates to a rather complicated systemic property which, in principle, can have only partial descriptions. (A complete, exhaustive, description of it would turn it to a context-insensitive concept.) There may be descriptions of various ways in which CSR fails, say by overlooking some of the relevant dimensions of sensitivity to the context, or by malfunctionings of some or all of the components of a practice. It can also be said that a crucial component in retaining and entertaining CSR is the capacity to develop meta-levels and to ascend to them as is required by the context. This ascent is required: (i) to judge the situation of the practice from these meta-levels, (ii) to direct and control the practice by exhausting the current potential and developing future's potential for this direction and control of the practice, (iii) these call for evaluation and judgment of various methods (heuristic and algorithmic) as appropriate for (some segments of) the situation, (iv) for supervising the performance of these methods, (v) for monitoring the results, (vi) for receiving and absorbing supplementation from the context, and (vii) to judge the whole pattern of meta-levels, relationships among them and the performance of the practice as appropriate, well-tuned and well-executed. When CSR (or, better, a CSR-instance) serves as an R-concept for policy issues then the above mentioned pattern of relationship involves judgments from suitable meta-levels about the adequacy of some levels of meta-policy and policy, the heuristics used, the well-tuning, the results, etc.

The lesson of this subsection is simple, though perhaps the subsection itself is not. The quest for a simple, solid expression of the content of CSR should be abandoned. For it is only a left-over from CFR.

5.3.2 CSR, Other Views of Rationality and Some Open Questions: Some work remains still to be done. While this dissertation attempts to close the question about the R-concept which is adequate for policy theories (MQ; 1.1.1) some other questions are opened by the very attempt taken here. For example, the relationship between the normative and the descriptive, or between creativity and analysis are touched upon (and used) but not discussed thoroughly. The results which emerged here lead to some views concerning them, yet a systematic discussion is deserved. More generally, AMTIT (Ch. 2) which indicates that the gap between rationality as an ideal and as a concept or a theory is unbridgable can be interpreted as a challenge to a formalist-empiricist tradition in the theory of rationality. What are the consequences if this tradition is abandoned? What are the implications for other areas of philosophy and for the social sciences of the acceptance of CSR? Or, to narrow the perspective, what is a theory of policies based on CSR? These questions and similar ones which deserve some extended discussion are left for future work. (The dissertation is too long anyhow ...)

In what follows there is a brief survey of views about several issues pertaining to rationality which are seen in another light by the articulation of CSR, resemble some segments of CSR, or are subsumed by it. No attempt is made to make it comprehensive. This condensed survey also shed light on some additional questions which wait for future work. This is done in 5.3.2.2. In 5.3.2.3 the question about the exhaustiveness of the account of rationality given here is addressed. We begin in 5.3.2.1 with a short discussion of a pair of R-concept which superficially seen can be said to say that CFR and CSR are superfluous.

5.3.2.1 Simon's Substantive vs. Procedural Rationality and the Pair CFR and CSR: In two papers Simon (1976, 1978) introduces a distinction between "substantive" and "procedural" rationality. The relation between his distinction and the CFR and CSR pair is examined. It found that:

(i) Simon's distinction mixes up an ontological category, viz., "substantive" with an epistemological one, viz., "procedural,"

(ii) Simon's procedural rationality is that R-concept whose domain is composed of instrumental choices treated by externally guided instrumental heuristics.

Substantive rationality, says Simon (1976, p. 66) "grew up in economics."

> "Behavior is substantially rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints" (p. 68).

Procedural rationality was "developed within psychology" (p. 66).

> "Behavior is procedurally rational when it is the outcome of appropriate deliberation. Its procedural rationality depends upon the process that generates it" (p. 68).

In the 1978 paper this pair of rationalities is characterized thus:

> "In [a complex and interrelated] world, we must give an account not only of <u>substantive rationality</u> -- the extent to

> which appropriate courses of action are chosen but also of procedural rationality -- the effectiveness in light of human cognitive powers and limitations of the procedures used to choose action" (1978, p. 9).

When Simon's distinction is compared to the pair CFR and CDR, some similarities appear on the surface. But when examined more carefully the following two points can be made.

(i) Substantive and procedural simply do not contrast. In other words these terms do not refer to two disjoint subclasses of the class of rational behavior. Procedures of some sort are involved in "substantive rationality". On the other hand, a choice of an optimal alternative by way of erratic or idiosyncratic selection is not regarded as rational. An entrepreneur who succeeds to maximize his profits, say, by consulting cards readers is considered as lucky rather than rational. Two pairs of distinctions can be made; an ontological distinction, in which, say, process is contrasted with product, and an epistemological distinction between two kinds of procedures, algorithms and heuristics. Simon's pair mixes up an ontological category -- substantive -- with an epistemological one -- procedural.

(ii) More important is the second point. Simon's "substantive rationality" is a version of CFR. But what is contrasted with it, procedural rationality -- is far from CSR. His examples of procedures, selective search procedures for inter programming problems, and the theory of heuristic search, are kinds of instrumental heuristics, where the problem has to be given in advance, and so are the alternatives. The heuristics in these examples use different cues to shorten the search for the solution. The first kind utilizes approximation procedures which "permit a corresponding narrowing of search to promising regions of space" (1978, p. 11). The second kind utilizes the pattern according to which solutions are scattered non-randomly such that:

> "an intelligent system capable of detecting the pattern can exploit it in order to search for solutions in a highly selective way" (1978, p. 12).

The criterion for selection in these examples is maximization of some index. Conceptual novelty, the determination of the problem to be treated, or the settlement of objectives, cannot be handled by these kinds of heuristics. When it is recognized that, at least for policy theories, these tasks need also rational guidance, then Simon's influential advocacy of his "procedural" rationality may even be a hindrance. It has to be realized that there is more to rationality than either algorithms or instrumental heuristics.

5.3.2.2 **Other Views About Rationality, and CSR:** It could have been argued that ... if only there were no restrictions of time and length. So it will not be argued, but only mentioned. Although the philosophic bent calls for arguments these will be deferred for future work

From the vantage viewpoint of CSR, the following, somewhat imperialistic picture emerges. The well known controversies between Popper, Kuhn and Feyerabend (e.g., in Lakatos and Musgrave (1970)) seems to revolve around an unrest with RVR, without full awareness of it, about groping for something to replace RVR, but retreating from it. (Remember the epistemological role of RVR; 1.3 and Ch. 3.) Thus, in note 28 of Chapter 1, it is seen how Popper gave exclusivity to the rationality of communication and argumentation. He did it because otherwise, the only alternative perceived by him, namely RVR was seen (due to his interpretation of it) to lead to Utopianism and violence. The rationality of argumentation is clearly that of logic. Kuhn searched for an alternative to RVR which could have rationalized those radical changes in theoretical systems which he called "revolutions". This was enough for many philosophers and historians who continued to subscribe to RVR to label Kuhn "irrationalist". (Remember the epistemological role ...) Feyerabend felt that it does not make sense to give exclusive rights to RVR; that no R-concept is universally applicable. He jumped to the extreme conclusion that rationality should be scrapped (or so it seems sometimes) because he did not see any viable alternative to it. (This last point is claimed by Brown (1978).) When the rationality of science is taken to be a CSR-instance, then each of these three writers, and many others, can be seen as contributing to the elucidation of some segment or another, of some phase or another, of some stage or another. Mistakenly they saw themselves as having a real and deep controversy, while, from CSR's perspective it was not the case at all. The mistake each of them had was to give exclusivity to that segment he dealt with.

Several components of CSR had been argued by various philosophers; Brown (1977, 1978); Suppes (1981); McMullin (1980);

Wartovsky (1980) argues against algorithmic rationality. Putnam (1981, 1983) argues against "criterial rationality" which is a variant of algorithmic rationality whose premises are culturally accepted norms. McMullin (1980) argues for the inclusion of creativity with the realm of rationality. Nickles is known for his many attempts to incorporate the context of discovery within the realm of the philosophy of science, e.g., Nickles (1980, 1981).

The ascent to meta-levels which is a key factor in CSR has some affinities with Hintikka's account of the ancient method of analysis and synthesis (Hintikka and Remes, 1974), especially with the synthesis part of it. (See also Hintikka, 1974.)

This is only a short list. It could have been extended easily. One word about one philosopher which was not mentioned in this condensed survey. It seems that CSR can account for some of Churchman's (1968, 1971) (but also (1951); also Churchman and Ackoff (1946) and Cowan and Churchman (1946)) insights but as yet, I am not sure that for all of them.

5.3.2.2 But Is It The Whole Story?

Is it the whole story?

No. But should it?

It has only to be a scaffolding.

A scaffolding for scaffoldings.

NOTES

(1) It is interesting to note that the warehouse location problem provides a handy formulation for the original problem of the SACBS as discussed in Chapter 4. The logistic character of such a problem is immediate. (This way of modelling the SACBS problem is independent and separate from the issue whether it is to be solved by an algorithm or an heuristic.)

(2) Silver et. al. (1980) brings the following definition for a heuristic method as a procedure "for solving problems by an intuitive approach in which the structure of the problem can be interpreted and exploited intelligently to obtain a reasonable solution" (italics added). This definition is quoted from Nicholson (1971).

(3) Pragmatically ill-formed problems are discussed in the literature under various titles and characterizations. For example Mintzberg, Raisinghani and The'oret (1976) speaks of "unstructured problems". Simon (1967) discusses "ill-structured problems". The characterization given there are only partial relative to the one given in the text.

(4) "The question we have to ask is, in participant's language, "What happens to the light-rays when they enter refracting media? -- or to put the same thing in onlooker's language, "How are we to extend the techniques of geometrical optics to account for the optical phenomena we meet in the presence of glass, water and the like?" (Toulmin, 1953, p. 65).

(5) "Observers questions are concerned with the details of an interaction. They want to give a historical account of the interaction and perhaps, formulate laws, or rules of thumb that apply to all interactions ... Participant's questions deal with the attitude the members of a practice or a tradition are supposed to take towards the possible intrusion of another. The observer asks: what happens and what is going to happen? The participant asks: what shall I do? (Feyerabend, 1978, p. 18).

(6) The sense of simplicity is related to the mapping between events in the regulard and events in the regulator. The simplest mapping is identity. The sense of successfulness is that only events included in the goal-set obtain when the regulator exerts its influence on the regulated system.

(7) See, e.g., Churchman, Ackoff and Arnof (1956, pp. 185-274).

(8) As Popper (1957, p. 150) puts it: "[T]here can be no history

without a point of view ... [because] history must be selective." The selection of a point of view is the commentator's problem.

(9) Thus Knorr (1976) claims that "[t]here are no easy and reliable lessons to be learned from history" (p. 77). Later he argues that "the central problems in international threat-perception are not susceptible to technological solutions" (p. 87), but require complex judgments which cannot be computerized.

(10) Had an algorithm for solving meta-philosophic problems been available, these problems would have been settled by now. But they are not. In particular the nature of rationality would not have constituted a problem. But evidently it is. For a short list of meta-philosophic concerns and problems in the area of philosophy of science see Hooker (1975a).

(11) E.g., Beer (1975) (1979) and Kikert and Gigch (1980) use meta-systemic considerations involving several meta-levels in decision making.

(12) Stafford Beer expresses these ideas succinctly:

> "[There is a] need for constant flirtation with (what we usually call) <u>error</u> in any learning, adapting, evolutionary system ... Error, controlled to a reasonable level, is not the absolute enemy we have been taught to think it. On the contrary, it is a precondition of survival ... [Usually] the system's errors are wasted as progenitors of change, and change itself is rarely recognized as required. All the managerial emphasis is bestowed on error--correction rather then error-exploitation" (1979, p. 62).

(13) "[A heuristic] does not guarantee, however, that the search will be successful, or that it will not go down a number of blind alleys before it finds a correct path" (Simon, 1967, p. 167).

(14) This difference is similar to the one between logic and automata theory;

> "There is one important difference between ordinary logic and the automata which represent it. Time never occurs in logic, but every network or nervous system has a definite time lag between the input signal and the output response. A definite temporal sequence is always inherent in the operation of such a real system ... It should be emphasized again, however, that the representative automaton

contains more than the content of the logical proposition which it symbolizes -- to be precise, it embodies a definite time lag" (von Neumann, 1956, p. 44).

(15) For other heuristics of this sort see Muller-Marbach (1981).

(16) A standard text is Hillier and Liberman (1977).

(17) Arguments against the minimax and the maximum expected utility were presented in above, where the SACBS is studied. It is shown there that the criterion used in the SACBS cannot be reformulated in terms of either one of these extremization criteria.

(18) Liddle-Hart, the noted military analyst and historian has observed (1954) that in tactical decisions forces (and other resources) are allocated according to the goals to be accomplished. On the other hand, in strategic decisions goals are determined according to the recruitable resources.

(19) See for example, the table of criteria for typical problems amenable for treatment by operations research in Parsons (1967), where all the criteria are either a maximization or a minimization of an index related to the problem. All these problems are operational or logistical. In our terms they are tactical.

(20) See Howard (1980, p. 6) for an explicit statement, also Raiffa (1968, p. 271). See the discussion above in Chapter 1, of RVR. Newell and Simon (1972) provides this statement: "Each problem generates subproblems until we find a subproblem we can solve--for which we have a program stored in memory. We proceed until, by successive solution of such subproblems, we eventually achieve our overall goal -- or give up" (p. 27).

(21) Manheim (1968) has argued since the 1960's against the exclusivity of computational reasoning in transportation planning.

(22) The idea of "supplementation from the environment" or the context, is taken from Ashby (1956, Ch. 14). Ashby discusses the amplification of regulation which is found in biological systems. The regulators with which mammals are equipped from birth, i.e., those directly determined by their gene-pattern, do not act immediately for the mammal's advantage. On the other hand, "by the time adulthood arrives [the mammal has] a much better regulator (i.e., of larger capacity) than could have been produced by the action of the gene-pattern directly.

> Whence comes the supplematation? From random sources ... and from the environment itself!

> For it is the environment that is forced to provide much of the determination about how the organism shall act. Thus gene-pattern and environment both contribute to the shaping of the fully developed adult, and in this way the quantity of design supplied by the gene-pattern is supplemented by design (as variety and information) coming from the environment" (p. 271; italics added).

Similarly with practices. Concepts are too abstract to immediately direct and control practices by themselves. Supplementation from the context is required to enrich the relevant CSR-instance as to make it capable of directing and controlling the practice.

(23) The sense of orthogonality used here follows Sommerhoff (1969, p. 155):

> "Two variables are orthogonal if the value of the one at any instant of time does not determine the value of the other for the same instant."

Thus, the direction and rate of the future-oriented effort do not determine the degree of exhaustion of the presently available potential, and vice versa. Of course the two efforts are intricately connected in the long run. The amount of direction and control which can be actualized at any time is influenced by the long run future-oriented effort of enlarging the potential. On the other hand the future-oriented effort can unfold only through the experiences of presently-oriented efforts and their reflections in the relevant meta-levels. But for the same instant these two efforts do not determine the values of each other.

(24) 'Maximization of potential' over long periods of time is the core of Hooker's (1975a) conception of rationality; "A rational man so acts as to maximize human potential ..." (p. 214). In Hooker (1982) that which is maximized by "progressively evolving species" (rational beings, in terms of this dissertation) is the "access (or perhaps potential access) to parameter space" (p. 150) (which is, in my terms, simply the potential for direction and control). The future-oriented effort of enlarging the potential (which coheres with Hooker's evolutionary perspective) should be coupled with a present-oriented effort (just as there is no phylogeny without ontogeny).

(25) See note 22 above.

(26) See for example, Dantzig (1963); Hadley (1962).

(27) Thus Brown claims:

> "Yet this identification of rationality with algorithmic computability is a mistake, for the use of an algorithm is neither necessary nor sufficient for rational behavior (1978, p. 244).

He does not speak of various concepts of rationality, each with its unique features.

(28) For example, Hempel (1965) uses an R-concept borrowed from decision theory (a version of RVR or CFR) as determining the pattern of rational explanation of action. In Putnam's (1983) view; "Explanation shares with justification the characteristic of being action-guiding. Explanation is interest-relative and context-sensitive (pp. 296-7).

(29) See Deising (1962) for the examples. Deising uses, a different terminology. What is called here "systematization" he calls "rationality."

(30) Some other results which pertain more directly to philosophy of science can also be drawn. E.g., (3) The development (with accumulated experience) of method and meta-method is as important as the development of theory and practice. (For method directs both of them.) (4) It follows that the ascent along the control hierarchy (practice theory, method) has a crucial role in context-sensitive philosophy of science as well as in the theory of rationality itself. These claims are argued from a different basis by Hooker (1975a, 1975b, 1977, 1982).

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