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Institutional Self-Organization: Exploitation of Recent Advances in the Prescriptive Sciences

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Institutional Self-Organization: Exploitation of Recent Advances in the Prescriptive Sciences

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FOREWORD

One component of the Advanced Research departmental mission is designed to accommodate our intimation that the future of management science—in the sense of its distinctive opportunity—lies in the domain of "second-generation" decision problems Research in this area is concerned with issues of optimal strategy, optimal policy, and optimal organization that are not amenable in principle to conventional methods of systems analysis. With its emphasis on the concept "institutional self-organization," this paper attempts to (1) capitalize early on a particular feature of optimal organization noted in the course of broader studies and (2) bring this feature immediately to bear as a consideration in institutional systems design for a society subjected to a rate of technological change that tends to nullify previous experience and habitual strategy.

For convenience the central concept is elaborated here in the national administrative context, but there is a decidedly open question as to whether the predicated innovation might not be more appropriately posed as an academic, philanthropic, or nonprofit corporate enterprise.

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ABSTRACT

The rampant acceleration of scientific advance and technological change that seems to be required for national preeminence unfortunately entails disconcerting human consequences: explosive increases in cultural complexity with ominous possibilities for massive social disruption. The attainment of social adaptivity, as an ideal resolution of this situation, can be predicated only on the basis of sophisticated improvements of rational control throughout the hierarchical range of institutional decision making. Recent advances in the management sciences, when exploited in an institutional version of a self-organizing system, constitute promising theoretical resources for extending the present scope of rational decision. A feasible design for a national administrative research agency is put forward in concept, as an institutional prototype embodying the innovative organizational format needed to connect theoretical resources with practical aspects of social problem solving. The significance of this prototype lies in its implication for a deliberately self-transforming society, a purposefully adaptive version of the social order.

INTRODUCTION

It is a testament to the subtlety of the cultural process that individual men, aligned by their responsibilities in social institutions, can accomplish complex tasks of decision, valuation, and organization and yet be quite incapable of specifying how such tasks are to be reliably performed. The disparity between those mental operations that administrators can somehow contrive to execute and those that they can rigorously program is so great that the exploration of the "inner space" of cognitive organization is a task at least equivalent in scope to that of discovery in the outer space of the physical cosmos.

Yet, to say that the accultural human can unaccountably, that is, intuitively resolve complicated decision problems is not to say that the results are incontestable. On the contrary, the most confident employment of unexamined habitual procedures in decision making have all too frequently led men, societies, nations, and even civilizations to destruction. Thus a commitment that must once have been dimly hypothetical has by this time been accepted as a common sense maxim, that it is an always cogent enterprise to attempt the formulation of organizational principles that will tend to ensure desirable long-range outcomes of decision rather than mere chanceful unforeseen results. The strength of this maxim is that it invokes precisely the principal aim of rationality, namely, the design of cognitive controls that are capable of redirecting and refining the naturally artful but insecure operations of intuitive judgment.

It is the purpose of this prospectus to advance the concept of an innovative organizational format that appears to hold unusual promise for the attainment of improved rational control of decision making in the bewildering context of contemporary national administration. It need not be supposed, however, that the ensuing institutional design will be relevant only for a special agency of national government. The predicated institutional structure, mission, and function can effectively contribute toward more rational and humane solution of social problems from a base of support in any of the several establishments that influence the life of the nation, such as university research centers, scientific advisory nonprofit corporations, and philanthropic research institutions. The "national agency interpretation" is adopted here only for the convenience of depending on direct effects that are so readily envisioned in this application.

NATIONAL ADMINISTRATIVE DECISION MAKING: PRESENT PRACTICE AND PROJECTION

Institutional decision, as conducted in democratic societies, consists in experimental compromise of conflicting interests reconciled in terms as

equilibrium and maintained by pragmatic adjustment to clear and present stresses. As to specifics, the tactical treatment of critical national administrative problems is the laboriously refined procedure of "staffing the decision"—a multifaceted process so complicated as to defy explicit description. Its principal features are clear enough: the traditional dependence on insight and intuitive judgment on the part of responsible individuals of proved talent and on intensive, though necessarily informal, exercises of reasoning and deliberation in which both criticism and justification are derived from many sources of specialized interest and competence. Coupled in unspecifiable ways with this basic procedure are innumerable subsidiary factors of decision making: the ethical authority of long-standing cultural commitments, the practical assessment of historic decisions and their consequences, the expertise of professional advisers, the exploitation of critical and constructive insights that an open society exhibits from every sector of intellectual activity, and, certainly not least, the interplay of leverage and influence in the political arena at large.

The sustained impetus of the American state in its drive toward international preeminence attests the notable skill and dedication with which this high art of institutional decision has here generally been performed. Yet even the most generous assessment of the viability and organizational effectiveness that can be achieved by experimental compromise admits of a disquieting aspect. This generation is witnessing, as the result of a "scientific revolution," perhaps the most spectacular and violent perturbation of the cultural human context ever recorded. It is now clear that an inevitable concomitant of scientific and technological sophistication is a drastic increase in cultural complexity, characterized by a dismaying rate of acceleration.

With intensification of this effect in time, critical social dislocations are only too readily conceivable as consequences of the very scientific advances that are obvious prerequisites for the viability of a modern national community as a whole. Now-familiar estimates of the impact of (a) explosive overpopulation, (b) industrial automation and the ensuing devaluation of traditional skills, and (c) depletion or spoliation of natural resources evoke a sharp sense of impending crisis for industrialized societies. Such disorders can become self-amplifying and therefore so unstable as to be relatively unpredictable; thus, great risk of massive social disruption is entailed.

This general problem, which in less severe form has continually beset modern society since the advent of the Industrial Revolution, admits of an equally general solution by way of an idealized capability that might be termed "social adaptivity." The promotion of social adaptivity—that is, the provision for orderly, evolutionary transitions at the cultural base of a national community instead of violent and wasteful revolutionary upheaval—has become one of the principal functions of democratic government. To this end the legislative and executive branches of the US Government attempt enlightened adaptation of missions, organizational structures, immediate goals, programs, allocation strategies, and budgeting procedures throughout the national complex.

The omniscience that would be required for the formulation of authoritarian directives is no part of the claim of the eminently practical men who must bear high political responsibilities. The intricacies of the federal estab-

lishment do not admit of any such singular comprehension. In the face of possible cultural impasse, as in the face of more pointed threats of military conflict, only the elemental necessity to emphasize truly essential commitments can be conceded unquestioningly. The premise of "first things first" is the only unimpeachable strategy so far set forth; but, in view of the expertise required to assess priorities among highly specialized sectors of public welfare, the various agencies of government can only conduct, on their own terms, the analysis and evaluation necessary to (a) reprogram-renormalize-reorganize their own structures, missions, and functions and (b) calculate and attempt to justify their respective claims on national resources.

To appreciate this situation in depth it is necessary to recognize clearly that the concept of control over a production-allocation process, so familiar and cogent for the ordinary uses of practical life, is simply inapplicable to the present conduct of national administration. The essence of the contemporary cultural enterprise is the creative refinement and reconstruction of existing knowledge, techniques in practice, services and commodities in use, and lifestyles in fashion. The ultimate social impact of a science-based technology is not specifiable in advance; its primary control principles are heuristic; its entrepreneurial thrust derives from the insight and imagination of innumerable innovators; and its accomplishments issue in ultimate practical benefits and costs by way of chains of ecological and social relations so complicated that only extensive analysis could establish their eventual contribution in terms of human welfare. A society in the era of scientific revolution is therefore most adequately construed as an evolutionary proliferation of successively modified ways of thinking and living, where creativity, aesthetic or rational selection, and learning represent advanced analogs of biological mutation, natural selection, and instrumental adaptation. Thus there may be little wonder at the difficulty of national administrative decision. The task imposed is one that lies necessarily at the extreme reach of the administrative function, namely, the "management" of an evolutionary process

This reconstitution of governmental function in terms of an evolutionary process must give pause to any credulous projection of the adequacy of present practice in national administrative decision making. It is apparent that demands incomparably greater than any so far experienced are going to be placed on the essentially intuitive methods of traditional institutional decision. Intuitive judgment can be a superb instrument of organizational control in a context that admits of cumulative experience and gradual change. But its reliability deteriorates markedly, if not disastrously, when confronted with drastic modifications of environment that disarrange major features of familiar experience and nullify habitual strategies that previously have assured viability.

INSTITUTIONAL DECISION AND THE PROBLEM OF RATIONAL CONTROL*

The viability of any organization depends ultimately on consistently effective practical actions rationally based on at least three considerations:

*Note that "rationality" is to be interpreted here in a much broader sense than the mere connotation of logical consistency. This term is to be associated with an idealized notion, namely, optimal design of a battery of criteria providing for systemic cognitive control. In App A this interpretation is elucidated with some detail.

conditional probabilities of events contingent on strategic options, utility of outcomes, as well as present states, and constraints imposed by limited resources. Although theoretically rational determination of action guarantees viability (if indeed that can be guaranteed by any means), it is apparent, even in this simplified context, that rationality may prove to be a highly elusive ideal. These pristine factors of rational analysis (probabilities, utilities, and constraints) may properly be construed as stable parameters of action-decisions only under the blazing presumption that at higher echelons of organization all strategic problems of evaluation and allocation are definitively resolved An alternative to the oversimplification of utility theory is the sweeping premise that only the injection of rational control at every level of organizational decision will ultimately assure effectiveness and viability. This truism at least unmasks the disconcerting range of intractable problems (Fig. 1) that actually constitutes the task of "rationalizing" institutional decision making.

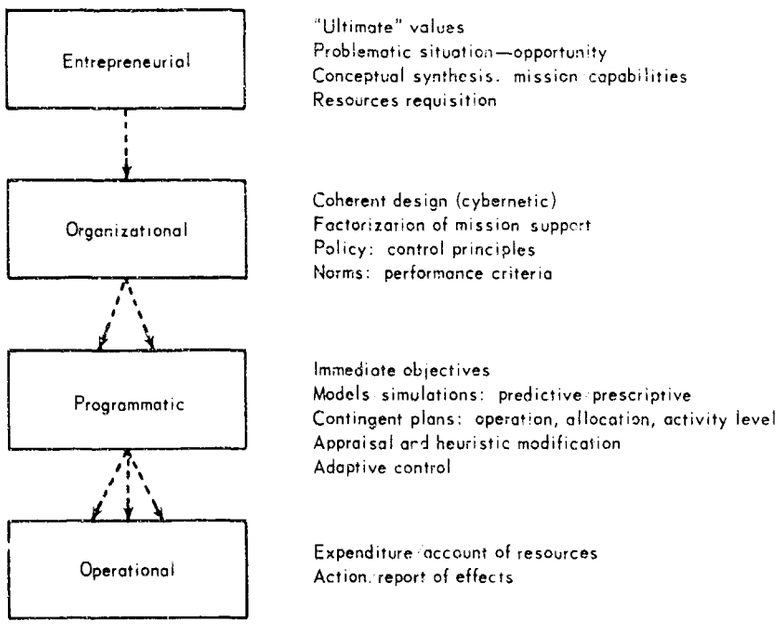

Fig. 1—Hierarchy of Practical Decisions

The central feature of this range of problems is an explosive increase of alternatives that is invariably set off by the exercise of creative intelligence. Decision connotes selection and presupposes freedom—the peculiarly human dimension of the cognitive capability. Cognition opens action-alternatives that must be resolved by means of simulation (i.e., the mental playing out of imagined courses of action) utilizing some particular conceptual model (essentially a theory) yielding anticipated outcomes by virtue of some characteristic program of the organization in question. At the same time cognition opens

possibilities for alternative programs that must be resolved by some definite conceptions of organizational missions and strategic objectives; finally, cognition opens missions-alternatives that must be resolved by some specific principles that serve, however provisionally, as ultimate value-commitments.

The import of this sequence is the realization that cognitive decisions are inherently relativistic. Practical decisions (by which we normally mean operational decisions) presuppose prior decisions, equally "practical," that successively involve the selection of values, missions, objectives, policies, strategies, models, programs, and procedures rather than immediate actions. The full range of practical decisions and the magnitude of the task of attaining rational control of institutional decisions must therefore be understood in terms of the hierarchical categories of (a) entrepreneurial, (b) organizational, (c) programmatic, and (d) operational decisions (see Fig. 1). A chain reaction of cumulative freedom of choice is initiated in every instance of the entrepreneurial recognition that certain social values can be served by the creation of an "agency," specially designed and endowed for the prosecution of envisioned missions and general objectives. From every such inception, responsible administrators are confronted by subsequent demands for decisions-beyond-decisions, and their requirements for rational control cannot admit of anything less than adequate response throughout the following typical array of institutional decision problems:

(a) Conceptual synthesis of combinatorial missions/capabilities that will best advance ultimate values (expressed in terms of fundamental problems resolved and strategic opportunities exploited).

(b) Justification of institutional requisitions against limited national resources.

(c) Coherent organizational design by factorization of missions and objectives for suborganizational levels; establishment of decision principles (policies) and performance criteria (norms); cybernetic design of communication/control structure optimized for intelligence acquisition and operational effectiveness.

(d) Selection among alternative predictive models and methods of analysis providing expectations of performance and, even more significant, prescriptive models and methods relevant to continual evaluation and adaptive modification.

(e) Selection of immediate goals and structuring of goal-oriented programs.

(f) Formulation of decision procedures yielding unambiguous determination of activity levels, program mixes, and allocation of resources.

RESOURCES OF MANAGEMENT SCIENCE

The history of rational inquiry per se is the record of the pervasive efforts of men to extend the adequacy or to repair the breakdown of habitual ways of thinking and acting. Thus it is that a contemporary sense of both

overwhelming difficulty and massive opportunity has given rise to new disciplines—the management sciences—that address the scientific advisory task of contributing to the improvement of rational control, so far as that may be possible, in the complex context of organizational decision making outlined previously.

The methodological development of the management sciences has so far emphasized the attainment of (a) explicit procedures in operations analysis and rigorous optimization techniques (e.g., cost-effectiveness analysis, mathematical programming, analysis of stochastic processes, utility theory, and microeconomics); (b) subsidiary decision models (e.g., macroeconomic models, input-output tables, and network flow models); and (c) operational simulations as aids to planning (e.g., PERT, PARM, SAM, and TEMPER). Management science currently possesses demonstrated capabilities in optimization problems that admit of quantitative criteria for the elemental objectives of maximal effectiveness and optimal resource allocation for an organizational subsystem. Impressive advances have been made regarding problems specifically involving the operational level of decision making.

After it is conceded that formulation of rigorous decision procedures, operational simulations, and predictive models constitute legitimate concerns of objective scientific inquiry, crucial problem areas associated with valuative aspects of practical decision remain. These areas comprise a domain of "second-generation" problems (Table 1) for management science and require

TABLE 1

Second-Generation Problems

(Demands of the future in the prescriptive sciences)

Decision levels	Type of value problem	Characteristics
Entrepreneurial	Holistic	Terminal values and alternative missions, justification of resource requisition, balanced "portfolio," combinatorial missions/capabilities
Organizational	Instrumental	Optimal organization: structure, communication/control, policy/norms, management models, decision procedures
Programmatic	Interface	Resolution of conflict: program objectives, strategies, activity level, resource requirements
Operational	Suboptimal	Allocation of resources, effectiveness measures and maximization

a distinctively normative, or prescriptive, mode of rational inquiry. Traditional objective scientific methods have been formulated specifically to provide a predictive-explanatory capability, and it can be shown that such methods are therefore incapable, in principle, of providing an adequate rational format for a prescriptive control capability applicable to the value problems summarized as follows:

(a) Holistic (value) problems concerning identification of ultimate values, selection among combinatorial missions/capabilities, justification of requisitions on national resources, assembly of research/development portfolios balanced for attainment of immediate effectiveness vs long-range viability.

(b) Instrumental (value) problems associated with the optimal design of organizational structure and communication-control functions, evaluation of policies and performance norms, assessment of alternative management models and decision procedures.

(c) Interface (value) problems involving resolution of conflicting program objectives, immediate goals, activities levels, and resource requirements among components of a complex organization.

It is clear at once that research directed toward the achievement of rational methods for problems of this scope and complexity must involve a new order of theoretical difficulty. Of all intellectual enterprises the attempt to provide a rational basis for value judgment has perennially proved to be the most refractory. If valuative problems are to be placed at the center of interest for an expanded version of management science, what mode of inquiry may be taken as adequate in view of the limitations of objective scientific method? This question inevitably forces the rudimentary management sciences into an unfamiliar region of metascientific issues. In effect it embeds the projects of management science in a new and more general context of inquiry: the range of the prescriptive sciences (Table 2).

TABLE 2

Range of the Prescriptive Sciences

Management category of practical decision making	Prescriptive science		
	Applied	Theoretical	Metatheoretical
Entrepreneurial	Intuitive factorizations	Normative theories—decision, valuation, organization	Philosophical reconstruction
Organizational	Decision models	Management models	Rational paradigm
Programmatic	Simulations	Analytical procedures	Unified methodology
Operational	Suboptimizations	Optimal-decision processes	Complementary modes

Gaining impetus from attainments (and limitations) of the early management sciences, a fundamental project of philosophical reconstruction is now in progress. This current program of research is an attempt to extend the domain of rationality by establishing metatheoretical foundations for the general theories of decisions and valuation that are required for the formulation of management models relevant to such issues as optimal strategy, optimal policy, and optimal organization. The broad objective of this research is to formulate a unified paradigm of inquiry in which the currently disparate methodologies of axiomatics, experimental science, and axiology (or value-inquiry) could be construed as coherent and interdependent perspectives for rational treatment of

the wide range of decision problems actually encountered in administrative decision.

Results of research on foundations of the prescriptive sciences so far involve the following innovations:

(a) Conceptual schema: reconstruction of primitive concepts and commitments in a system-format characterizing the organization of admissible conceptualizations in general.

(b) Canons of rationality: comprehensive criteria providing systematic tests for the admissibility of cognitive models; that is, formal, predictive, or prescriptive theories in general.

(c) Paradigm of rational analysis: a "normative" rational prototype (or representation-scheme) admitting of predictive and prescriptive interpretations that are formally primal-dual, therefore mutually complementary.

(d) Unified methodology: operational integration of the supposedly disparate methodologies of axiomatics, experimental science, and axiology (or value-inquiry).

(e) General theory: preliminary versions of general theories of decision, valuation, and organization that are generated by the normative mode of inquiry.

Whether the development of a normative-theoretic perspective for inquiry can ultimately provide a conceptual and methodological format capable of broadly effective rationalization of practical value judgment is, of course, a matter for future assessment. It seems apparent, however, that the recent conceptualization of a prescriptive mode of rationality opens the most promising avenue we now have for the preparation of a more adequate response to the complexities of institutional decision making.

The principal intention of this paper is to point out the possibility of employing a significant new strategem, namely, "forced draft" development of the normative-prescriptive sciences for the attainment of methods of analysis providing improved capabilities for comprehending and modulating the social effects of technical developments now issuing primarily from advances in the objective-predictive sciences. In the most general terms this is the possibility of inducing in rational inquiry a special concentration on innovative methods for assessment and optimal implementation of the total range of innovations resulting from the pursuit of inquiry as a whole. It is the possibility of turning the view of rational inquiry on its own performance in a manner roughly analogous to the development of human self-consciousness.

A FUNDAMENTAL ORGANIZATIONAL STRATAGEM

The key to an appreciation of this stratagem is the concept of a reflexive version of adaptive control. Even the most cursory analysis of evolutionary phenomena reveals a remarkable competitive advantage that is acquired with the self-organizing mode of adaptivity (apparently peculiar to Homo sapiens) associated with the dual capability to think directly about how to act and to

think reflexively about how to assess, utilize, and improve the process and results of thought itself. In effect, the proposal of concentrated development in the prescriptive sciences constitutes a proposal to appropriate this fundamental reflexive stratagem of self-organization that is, so far, characteristic only of the human individual as an organism and, for the first time, to exploit that stratagem systematically in the wider context of an organization of human individuals, a social institution. This amounts to the deliberate emphasis of a singular feature of organizational design that the process of natural selection has unknowingly vindicated as supremely advantageous. In terms of immediate interest, such a strategic commitment offers the promise of improved rational control of practical decisions in an environment where the pace of natural change is drastically accelerated by the advance of inquiry in general.

The attainment of this objective would constitute perforce a basic contribution toward accommodating the "scientific revolution" by means of a process of social adaptation. Such an accomplishment would have a long-range significance impossible to overestimate. The society that first incorporates an institutional version of the self-organizing mode of adaptivity will have made an incomparable advance toward optimal organization. The competitive leverage so obtained will undoubtedly constitute one of the principal factors supporting sustained viability and national preeminence in the future. In the USSR a massive concentration of interest and resources on the cybernetic problem* of optimal control in man, machine, and society attests the fact that some version of this consideration is already recognized by our principal national competitor.

To consider the proposed stratagem as if it were appropriate primarily in reaction to international threat, however, would constitute a serious foreshortening. By contrasting alternative social-political conceptions, a larger positive aspect of the undertaking can be comprehended.

The democratic heritage typically yields the realization (deeply obscured by totalitarian commitments) that optimization of control represents only one aspect of organizational improvement. To those schooled in continual sensitivity to the personal worth and dignity of the human individual, it is readily apparent that, in addition to the extension of rational control, the general increase of freedom must represent a complementary condition for improved viability and effectiveness in social organization. This is to perceive (as the totalitarian does not) that creativity and rationality are separable only as figments. The general problem of rational control does not admit, in principle, of any final solution other than the attitudinal one of purposeful alignment with the creative process, and with the pliant and eager acceptance of the indefinite refinement of organization that this alignment entails. Such an alliance of rationality with creativity can issue only in the opening of new alternatives for the satisfaction of needs, and finally, even the gradual transformation of humanly limited conceptions of ultimate values.

Maximal freedom and optimal control are dual criteria of optimal organization. This commitment, however inexplicitly given by tradition, is

*Cf. "Soviet Cybernetics: Recent News Items (Series)," in W. B. Holland (ed), monthly issues in translation, RAND Publications, Santa Monica, Calif., Feb 67 ff.

recognizable as an enduring theme of democracy. This theme acquires its deepest significance from its status as a singularly crucial option, for surely no option is more critical than the selection of value criteria that are to apply to the ultimate assessment of overall accomplishment and present condition of an organization as a whole. Optimal organization—admittedly an idealization—connotes long-range viability of strategic posture in combination with continuous effectiveness of tactical action for relief of stress and attainment of immediate goals. This concept is so general as to be perhaps universally applicable. Such a generic ideal no doubt characterizes the ultimate objective of every social institution that ever has existed. Distinct options, and thus fateful differences among institutions, have their sources in alternative interpretations of the criteria of optimality that are independently conceived and adopted. At the heart of the democratic conception is the unique and tenacious insistence that a complicated balance between the counterposed criteria of freedom and control (or creativity and rationality) must characterize the ideal mode of organization that could ultimately serve the fullest range of human ends.

The significant positive aspects of the proposed stratagem therefore stem from the fact that the development of an institutional version of the self-organizing mode of adaptivity may be construed as a natural and direct implementation of our central traditional commitment. In final analysis the worth of the proposed innovation must be assessed in terms of the plausibility of this claim: that the adoption of the self-organizing strategy would signal the advent of a new species of social organization—a deliberately self-transforming society—and that this development would powerfully sustain the social venture that began long ago with the humanist conviction that free men would ultimately be capable of bringing their collective ideals into practical reality.

IMPLEMENTING THE STRATAGEM: SOCIAL SYNTHESIS

The identification of a fundamental organizational stratagem has depended quite openly on the uses of intimation and analogy. These procedures are essentially justified by a time-honored precept: Learn from nature. By abstracting a significant feature of development common to Hominidae, and extending far beyond the limits of direct human experience, a principle of appropriate scope may be obtained to serve as a directive for our own future. If this precept is adopted as a guide to action, the course of nature immediately yields a cogent insight regarding a general plan for implementing the self-organizing stratagem.

The emergence and the subsequent development of individual self-organization are attributable to the corresponding emergence of a singular modality of behavioral control. The fixation of the habitual activity of symbolizing and controlling action by the construction-manipulation of conceptual models represents the central evolutionary feature that distinguishes man. This unique line of adaptive modification, associated with the appearance of idea and symbol, mind and model, thought and language, may be characterized as the acquisition of a general-purpose agency of the organism as a whole, specifically, a conceptual modeling agency. It is by virtue of this semiotic (or symbolizing)

facility that the cognitive dimension of freedom is accessible to the human organism, and it is the strategic capability of the cognitive-semiotic subsystem for mapping-modeling-simulating the whole organism in environment that admits of deliberate, reflexive control and creativity in the self-organizing mode of adaptive behavior.

With regard to the question of how to implement the self-organizing stratagem in a social institution, the outlines of a general plan are unmistakable. The requirement is to design and incorporate a general-purpose social agency capable of executing the following missions associated with conceptual modeling of the complex programs and contingent plans that determine the characteristic response of the national administration as a whole:

(a) Descriptive analysis of characteristic structure, function, and present state of the organization-in-environment (essentially intelligence acquisition via mapping, modeling, and simulation).

(b) Predictive evaluation of the impact of current operations and programs in correlation with environmental and organizational trends (essentially measurement of effectiveness and viability, diagnosis of present needs, and anticipation of stress).

(c) Prescriptive design of putative improvements in operational, programmatic, and structural aspects for consideration by responsible administrators (essentially the role of change-agent in the interest of adaptive organization).

(d) Methodological research aimed at extension of currently limited technical capabilities in analysis, evaluation, and design (essentially cognizance and exploitation of current advances in the prescriptive sciences with a view to attainment of theoretical models applicable to decision problems of increasing scope and complexity).

(e) Metatheoretic inquiry as an attempt to extend the conceptual foundations necessary for the formulation of sufficiently explicit theories of decision, value, and organization.

In disciplinary terms these component missions are the enterprises of (a) applied operations research and systems analysis design, (b) prescriptive-scientific methodological research, and (c) general systems research, respectively. In entrepreneurial terms these comprise just the combined sectors of objective and normative scientific inquiry most relevant for the acquisition and implementation of a reflexive mode of institutional adaptation.

It is not immediately apparent that this organizational formula differs significantly from the pattern of centralized administration that has been intuitively developed from the earliest forms of national grouping. Two important distinctions do exist, however. First, in view of sheer cybernetic limitations, the complex "interface" problems associated with any consideration of total national interests do not in principle admit of treatment by detailed analysis under conventional national administration. Such problems are encountered only at the level of aggregation associated with the responsibility of a chief executive, and even the remarkable resources of contemporary executive

offices are yet so limited by mere information-processing capacity that drastic reduction of the significant factors of decision constitutes the only practicable mode of problem solving. Second, in the face of an admitted lack of warrantable decision procedures, adequate management models, and applicable theories of valuation and organization, the operations of a national administration in the conventional format are subject to improvement principally by the fortuitous injection of new techniques and principles rather than by the systematic output of a concerted program of research specifically directed toward the concerns of administrative decision making.

A centralized agency capable of the predicated analysis research mission would therefore constitute a thoroughly innovative type of suborganization, an adjunct of administration that has so far only been intimated by the employment of operations research and systems analysis in government. Hence there can be no easy assumption that the process of social synthesis required to initiate such a basic modification could be simple or straightforward. What is involved, essentially, is commitment to the concept of a fourfold mission and a fourth estate of government. In this conception the traditional judicial-legislative-executive partition would be supplemented by a scientific-advisory sector devoted to (a) the reflective function of analyzing the contingencies of a continuous feedback relation among options, decisions, and effects and (b) the creative function of formulating more adequate criteria and more warrantable procedures for the selection of organizational structures, programs, and operations that tend toward maximization of given* ultimate values.

Without engaging in premature consideration of detailed features of a prototype that might now be designed, the following section outlines the basic concept of an eminently feasible national agency that, if instituted, could be expected to contribute to the immediate effectiveness of administrative decision and the future viability of the US in a measure beyond the reach of present assessment.

CONCEPT: NATIONAL ADMINISTRATIVE RESEARCH AGENCY

The functions of the proposed agency are stratified by distinct requirements for (a) analysis and applied research, (b) theoretical inquiry (basic research), and (c) foundational or metatheoretic investigation. An organizational pyramid (Tables 3 to 6) is therefore indicated, the base agency (Operations Research Service) being supplemented by a less extensive research and development subsidiary (Management Sciences Commission) and a relatively small academy-style affiliate for the conduct of advanced studies (National Institute for Unified Studies in the Sciences and Humanities). These three components

*The implication intended here is simply that collective social commitments on the part of the body politic must provide the specification of ultimate values. The identification of such values, the recognition of incompatible commitments, and the offering of alternative means of conflict resolution would all certainly lie within the province of the research function of this sector of government inasmuch as it is envisioned as attendant on an existing democratic establishment.

TABLE 3

Concept: National Administrative Research Agency

Component	Missions	General objectives
National Institute for Unified Studies	Metatheoretical studies Extend interdisciplinary milieu Deploy senior investigative talent	Philosophical reconstruction Unified rational paradigm Systems-theoretic schema
Management Sciences Commission	Methodological research Explore potential areas, new applications in operations research, systems research	General theories: decision, value, organization Normative mode of inquiry, theoretical models applicable to 2nd generation problems
Operations Research Service	Applied research, analysis, operations research, systems analysis, related fields Technical assistance: US Government departments, branches, services, agencies	Improvement of rational control in national administrative decision making: advanced decision procedures, simulations, models as analytical aids to programs (1) feasible as to constraints, (2) optimal re specified criteria

TABLE 4

Operations Research Service

Research area	Relevant disciplines
Optimal allocation	Plan-program-budget technique, cost analysis, microeconomics, utility theory, mathematical programming
Maximal effectiveness	Markov and queuing processes, sequencing theory, statistics, decision theory, mathematics of optimal control, systems engineering, analysis, cost-effectiveness analysis, [illegible] programming
Operational planning control	Inventory, production, and [illegible] models, distribution and service systems, [illegible] models, [illegible] tables, [illegible] and network flow models, game theoretic models

TABLE 5

Management Sciences Commission

Research area	Disciplines involved
Value, decision theory	Utility theory, mathematics of [illegible], [illegible] partial order theory, Theory of selective systems, Adaptive control processes, Psychology, behavioral [illegible], cognitive theory, Ethics, aesthetics
Organization theory	Mathematics of general systems, Pattern recognition, Communication theory, General systems research, Psychology, physics, [illegible], Biology, anthropology, mathematics, Sociology, Cultural anthropology

TABLE 6

National Institute for Unified Studies

(Sciences and Humanities)

Research areas	Modes	Relevant disciplines[a]		
		Somatic (substantive)	Semiotic (symbolic)	Noetic (conceptual)
Systems-theoretic schema	Analytic (formal)	—	Logic	Mathematical analysis
Unified rational paradigm	Objective (predictive)	Experimental physical sciences	Linguistics	Mathematical physical sciences
	Normative (prescriptive)	Management sciences	Aesthetics	Mathematics of optimization
Philosophical reconstruction	Synoptic (holistic)	Historical anthropological evolutionary disciplines	Thematics	Systematic philosophy

[a]Generalized only; see Table 7 for detailed listings.

of an interdependent complex are sketched out in terms of respective missions, general objectives, problem areas, and disciplinary specialties.

Operations Research Service

Mission. To conduct analyses and applied studies in the fields of operations research, systems analysis, systems design, and simulation in response to practical decision problems posed by the US national administration; to provide technical assistance for the development of in-house capabilities in the application of advanced methods of scientific decision making to problems originating in any branch, department, service, or agency of the US Government.

General Objective. To apply existing methods of operations research as technical aids to the improvement of administrative decision making; to develop specialized decision algorithms, management models, and simulations as analytical means for rational selection of programs of action that are (a) admissible in terms of known constraints and (b) preferable in terms of criteria of optimality specified by the originators of given administrative problems.

Research Areas and Analytical Techniques.

(a) Optimal allocation of resources for attainment of immediate goals under existing social, economic, technological, and physical constraints. The relevant disciplines are mathematical programming (essentially static-linear and nonlinear, though capabilities are increasing in stochastic, dynamic, and combinatorial programming), utility theory, plan-program-budget techniques, cost analysis, and marginal analysis (microeconomics).

(b) Maximization of operational effectiveness for programs committed to action; solution of problems associated with distribution of goods and services, activities and force levels, optimal component-mixes in complex man-machine systems, and logistic support and maintenance. The relevant disciplines are mathematical programming, Markov and queuing processes, sequencing

theory, statistical decision processes, mathematics of optimal control, systems engineering and analysis, cost-effectiveness analysis, and decision and value theory.

(c) Organizational planning and control for formulation of models of organizations and design of simulations permitting selection among alternative operational programs. (The ultimate problem in this area concerns the possibility of an adequate national management model as a coherent complex of component models.) The relevant disciplines are inventory, production, and quality control models; distribution and service systems; macroeconomics; input-output tables; graphs and network-flow models; and game-theoretic models.

Management Sciences Commission

Mission. To conduct a program of methodological research designed to extend the technical capability of the National Administrative Research Agency to respond adequately to decision problems of such scope and complexity that they are intractable under existing methods of analysis; to explore new areas for potential application of the techniques of operations research/systems analysis and related disciplines.

General Objective. To formulate systematic general theories admitting of significant interpretation in terms of both predictive and prescriptive aspects of decision, valuation, and organization; to establish, by this means, rational foundations for the construction of specialized theoretical models applicable to such issues as optimal policy, strategy, and organizational design in addition to the limited concerns of maximal effectiveness and optimal allocation that are now amenable to existing techniques.

Problem Areas and Disciplinary Specialties.

(a) General theory of valuation and decision applicable to appraisal of organizational performance; identification of ultimate values and selection of immediate goals; "interface" problems characterized by the general demand for resolution of conflicting values, objectives, missions, policies, and allocation requirements among components of complex organizations (national, military, corporate, and social-institutional); assimilation of material and intangible values; measurement of values. The relevant disciplines are variational mathematics (first-order perturbation theory and calculus of variations), general theory of selective systems, adaptive control processes, research on cognitive processes, social psychology, and contemporary ethics.

(b) General theory of organization capable of providing a basic systems-theoretic format applicable to the "entrepreneurial" problems of optimal modification of organizational structure, partitioning of missions and objectives, design of communication channels and administrative control functions, identification of criteria of optimal organization, and formulation and appraisal of strategy and policy. The relevant disciplines are mathematics of general systems, partitioning programming, communication-control theory (information theory and cybernetics), general systems research, developmental and physiological psychology (theoretical), biophysics and biology (theoretical), cultural anthropology, and sociology.

National Institute for Unified Studies (short title)

Mission. To conduct a program of advanced studies in the interest of attaining metatheoretical foundations capable of incorporating the normative (value-oriented) concerns of the humanities with the objective (knowledge-oriented) concerns of the predictive sciences in a coherent synthesis of scientific and ethical aspects of decision making; to undertake the construction of (a) a paradigm of rational analysis capable of providing an adequate conceptual schema for the formulation of predictive and prescriptive general theories predicated as objectives of the Management Sciences Commission and (b) a prototype of inquiry ultimately applicable to the improvement of rational control in decision, valuation, and organization; to develop and maintain a research milieu in which the creativity and expertise of senior investigators from all the intellectual disciplines may be brought to bear in a concerted effort to resolve the conceptual separation of knowledge, value, and action that currently impedes the development of more rationally effective and more thoroughly humane social organization.

General Objective. To attain an explicit formulation of a "systems-philosophy" that effectively assimilates and exploits the potent complex of new intimations currently issuing from specialized investigations in cybernetics, general systems research, analysis of creative-logical-aesthetic components of the cognitive process, methodological study of historic prototypes of scientific and axiological inquiry, mathematics of optimal control, and behavioral inquiry (psycho-social-biological); on the basis of a metatheoretic reconstruction or primitive concepts and commitments, to generate a unified prototype of rational inquiry that admits of (a) the coherence of scientific (factual) and ethical (valuative) aspects of deliberative decision, (b) the attainment of theoretical models applicable to classes of practical decision problems that are currently amenable only to subjective-intuitive solution, and (c) an improved understanding of the process of theory-construction itself as a creative activity.

Problem Areas and Disciplinary Array as Extension of Existing Work.

(a) Systems-theoretic schema: a conceptual format applicable to phenomena associated with organization and transformations of organization in general.

(b) Canons of rationality: a systemic collection of formal, empirical, intuitive-aesthetic, and evolutionary criteria as controls affecting the admissibility of alternative cognitive models, i.e., formal, predictive, and prescriptive theories in general.

(c) Unified methodology: operational integration of the supposedly disparate methodologies of formal science (logic-mathematics), experimental science, and axiology.

(d) Unitary paradigm of rational analysis: a schematic rational format possessing the formal property of duality and admitting of alternative interpretations identifiable respectively as objective and normative prototypes of analysis that are mutually complementary.

(e) Normative prototype of inquiry: formalization of detailed procedures for warranting prescriptive (as against predictive or formal) cognitive models and for applying the legitimate variant forms of analysis that ensue from alternative primal-dual rational modalities.

In Table 7 relevant disciplines are arrayed in terms of their respective modes of inquiry and categories of interest.

TABLE 7

Relevant Disciplines: Sciences and Humanities

Mode of inquiry	System category		
	Somatic	Semiotic (symbolic)	Abstract
Analytic		Formal linguistics; syntactics	Advanced algebra; mathematical analysis; general analysis: measure, relation, and modeling theories
Predictive	Physics; chemistry; biology; psychology; physical anthropology; sociology; economics	Linguistic analysis; semantics	Mathematical physics and biology
Prescriptive	Cybernetics; medicine-psychiatry; management science; ethics; jurisprudence	Logic; aesthetics	Variational mathematics; mathematics of optimal control; perturbation theory; statistical decision theory; dimensional analysis
Synoptic	History (social-political); history of science and philosophy; cultural anthropology; evolutionary biology; general systems theory	Thematic analysis; pragmatics	Systematic philosophy

CONCLUSION

The distinctive features of the proposed administrative research agency are the direct coupling of practical-theoretical-metatheoretical concerns and the dedication to achievement of a significant extension of the range of effective rational analysis. These features are clearly reflected in the strategic and tactical objectives envisioned: the establishment of a conceptual basis for coherent treatment of both factual and valuative considerations in administrative decision making and the attainment of analytical methods and theoretical models applicable to critical classes of practical problems that are currently intractable.

With regard to the intimation that real promise of organizational improvement is inherent in these features, little debate need be anticipated. The sen-

sitive issue for deliberation is whether this pattern of organization for advisory support of administrative decision, in contrast with the traditional format, represents a thoroughly acceptable innovation in means toward accomplishing the ultimate objective: a national society that is viably adaptive even in the face of explosive technological and social change. In view of the healthy skepticism characteristic of the American temperament in reaction to any suggestion of federal expansionism, this is an issue that must be worked out exhaustively.

It is a principal contention of this paper, however, that the contemporary era is so different from any other in the previous national experience that historical precedents must be continually reexamined for present relevance. The nation cannot afford to default on solution of actual problems by reason of doctrinaire formulations concerning freedom vs control or individualism vs institutionalism. For the future, the price of individual liberty—and of national viability—must be reckoned in terms of vigilance regarding the quality of organization rather than resentment of or resistance to some arbitrary measure of size or scope. The desirability of a national administrative research agency has been predicated precisely on the conception that the critical requirements of the future are for maximal freedom and optimal control, that is, for the encouragement of maximal individual creativity by means of optimal institutional organization.

The role of the envisioned agency, in summary, is to place at the service of responsible national administrators the widest range of imaginative new options and the most advanced principles of rational analysis that can be devised by a research organization broadly representative of the community of inquiry at large. This plan advocates an attempt to forge systemic connections between the practical and theoretical phases of social problem solving and, by means of this more versatile and responsive organizational design, to release more effectively the incalculable potential of individual creativity and rationality in the new context of a deliberately self-transforming society.

The promise of this emergent version of the social order has always been implicit in the human uses of intelligence in the long and arduous course of civilized development. It is the privilege of this nation to stand first within reach of its era of actual realization.

Appendix A

COGNITIVE RELATIVISM AND RATIONALITY

RAC

Figure 1 (Hierarchy of Practical Decisions) indicates that deliberative decisions in general are attainable only with respect to (or relative to) prior decisions, and ultimately with respect to a priori commitments. It is a poignant realization that this is no more than a variant of the Protagorean premise with which Western critical philosophy began. The hard-won achievement of two millenia consists primarily in boldly facing, rather than exorcising, this inherent relativism that is rooted in the nature of cognition. Relativism, as a primitive commitment, may be weakened to admit ultimate closure by absolute determinants of decision only at the price of foreshortening the conception of human freedom. Only a thoroughgoing relativism appears to be commensurate with the kind of freedom man has by virtue of the cognitive capability—the freedom to reconstitute deliberative decisions at any level whatever, the freedom of creativity. In cognition man found a new freedom, but with that prize he necessarily bore away also the unforeseen relativity of cognitive decision—a specter that has been the clamorous subject of radicalists in every generation.

It is a common prejudgment to suppose that this relativism must necessarily obviate the possibility of stable and viable principles as a foundation for the cognitive enterprise. Yet all that relativism actually entails is an immediate demand for cognitive control, a demand for the establishment of criteria of admissibility, however provisional, that are capable of resolving ambiguity throughout the hierarchical levels of decision and metadecision. Not sheer maximal freedom but optimal organization appears to be finally admissible as an idealized strategic objective for the cognitive system; and decidability, a condition associated with unambiguous selection among alternatives, is necessarily linked with freedom as a complementary criterion of optimality. Although the potential of the cognitive system for viability may be maximized by the creative capability, this potential can be coupled to practical action only by a corresponding control capability implementing selection among alternative conceptualizations.

It is generally observed that the nature of a problematic situation holds the clue to its solution. In this case the reflexive character of cognition, based on a semiotic dimension of freedom that is itself problematic, provides the means whereby that problematic freedom may be appropriately constrained; that is, it admits of the creative institution of successively improved criteria for the admissibility of a cognitive model, that is, for the selection among alternative cognitive models.

This problem of cognitive control, in traditional terms, is the problem of rationality; it is posed here in a manner that hopefully avoids two deficiencies that have perennially obstructed an adequate treatment. First, the reductionistic tendency to associate rationality solely with categorical or logically imperative control marks a failure to recognize that the problem

is essentially one of total self-organization on the part of a cognitive agent, a question of the optimal design of policies capable of providing for holistic-systemic cognitive control. This is to say that the creative institution of provisional, extralogical criteria throughout an escalade of practical, theoretical, and metatheoretical decisions has not been explicitly construed as a legitimate aspect of the rationalization of thought. Rationality has not generally been interpreted in terms of the optimality of a system of norms incorporating the total array of controls* expressly designed to foreclose the relativism of cognitive decision and so lead to determinative prediction, prescription, and action. An attempt to rationalize decisions in general is equivalent to an attempt to optimize the design of a control system for the cognitive process, where the control system must be devised by the reflexive use of the cognitive process itself. This "design-problem" interpretation of rationalization is only vaguely appreciated, and there, in short, lies the nature of the first of the two deficiencies.

The second inadequacy (actually a result of the first) is associated with the tendency of absolutism to consider the complex of rational control as insulated from evolutionary effects, thus severing the mental process of rationalization from its stem in the more general process of emergence. In contrast with the premise that human mental development involves emergent events that must be viewed simultaneously from biological-psychological-sociological perspectives, this conception presupposes that man, as the "rational animal," has a stripe that never changes. One aspect of the human personality, at least, is presumed to be exempt from modification—his rational nature. On this view of rationality as the control of thought and action in accordance with some specific set of absolute, immutable, universal principles, the admitted variability of individual and cultural commitments can be interpreted only in terms of an unexplainable obliquity on the part of certain misguided human assemblages. The resolution of conflict regarding alternative conceptions of "the" universal principles can then be conceived of only in terms of the violent process of dominance-suppression-revolution; the discontinuities that are emphasized by this version of process totally obscure an otherwise notable continuity within the anthropological proliferation of distinguishable versions of rationality.

Admittedly, certain principal commitments (primarily logical in character) are so fundamental to the control of thought that, since their explicit enunciation, no sane human being has been seriously disposed to suggest their modification. It is this evidence on which the absolutist depends for intimations of universality. But these commitments are but core-elements of the multilevel, multistage hierarchy of ontological, epistemological, axiological, syntactic, semantic, pragmatic, and aesthetic commitments that comprise the whole of a distinctive rational format. The persistent admissibility of logical "core-commitments" does suggestively parallel the even longer persistence of certain

*The "array of controls" associated with "rationality" comprises at least the following categories of criteria for admissibility of a cognitive model: (a) formal, (b) empirical, (c) pragmatic, (d) aesthetic, and (e) evolutionary. Familiar examples from each of these categories in order are: (a) syntactical well-formedness and logical consistency, (b) perceptual testability and reproducibility, (c) interpretability and practicability, (d) elegance or simplicity, and (e) meliorative trend or convergence to optimality.

fundamental features of physiological design that have recurred in every lower category of the phylum Chordata. And relativism, to be sure, must admit at the apex of any system of rational controls a collection of ultimate commitments effecting provisional closure and thereby serving qua absolutes—"hypothetical absolutes." The important distinction is that the entire system of cognitive controls shall be viewed, like any instrumental control system, as a modifiable feature of the overall design of an adaptive system; that such modifications, by virtue of their creative origin, shall be viewed historically as constituting an extrabiological lineage of emergent rational formats; and that the warrantability of any rational prototype shall be construed as ultimately depending on the adaptive advantage that it confers on the psycho-social-biological systems that apply that version of cognitive control toward the attainment of optimal organization in the continuing context of emergent events.

On this view it is not conceivable that man can have or attain rationality in any unqualified sense. No definitive condition can be attached to this term. The word "rational," like the word "good," denotes a completely general, idealized criterion—a concept having operational rather than substantive significance—open to any one of an indefinite number of interpretations given a specific context. It has the definite connotation of "systemic optimality of cognitive control," but this "optimality" cannot be independent of the cybernetic characteristics, objectives, norms, constraints, and the psycho-social-biological domain of interaction specific to the given cognitive system. Under the premise that all these factors are subject to dynamic or sporadic modifications occurring in the general context of natural selection, it follows that a considerable variety of competitive versions of "rationality" must have arisen. Insofar as the very notion of process presupposes some version of process-control, it must be allowed that every cognitive agent (even a psychoneurotic one) exhibits some version of rationality. Man therefore may not legitimately be viewed statically as the rational animal but rather as an animal peculiarly endowed with a dynamic capability for extending the degree and range of his rationality, i.e., for continually enlarging the scope of his domain of interaction simultaneously with the continual refinement of his approximation to optimal systemic control.

The so-called problem of rationality is not the kind of problem that anyone is ever going to solve in any sense other than the attitudinal one of purposeful alignment with an emergent process that involves the indefinite extension and refinement of self-organization. This is to admit that creativity and rationality are separable only as figments, a conclusion already suggested by the status of their respective correlates, freedom and decidability. Creativity and rationality represent complementary aspects of optimal cognitive organization, and the essential nature of cognition must therefore be understood in terms of an evolutionary process of optimization that is characterized by interdependence between (a) the creative function of conceptualization and (b) the rational function of selection among alternative conceptualizations.