THE USE OF LOGICAL MODELS IN POLITICAL SCIENCE

by

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PREFACE

The author's interest in this topic began with a research paper written for a graduate seminar in American political parties. Subsequent exposure to the works of such scholars as Anatol Rapoport, James M. Buchanan, Gordon Tullock, and William H. Riker made evident the fact that the use of abstract, deductive systems for the investigation of political phenomena was becoming a rather common methodological approach.

The use of logical models in political science, however, is not unique to this particular discipline. In fact, the natural sciences have used such models extensively. Furthermore, their utility in the natural sciences has undoubtedly been a factor in the attempt to apply logical models to social and political events. Because logical models as a methodological approach have been examined in greater detail by the philosophers of the natural sciences than by political theorists, this study draws heavily from the writings of R. B. Braithwaite, Ernest Nagel, Morris R. Cohen, and others who have analyzed the problems of scientific research.

The author is also indebted to the members of the Political Science faculty of The University of Michigan for their instruction and stimulation during the past four years. In particular, the author wishes to express his acknowledgement to his Doctoral Committee, especially to the chairman, Professor Frank Grace.

Ann Arbor, Michigan   George D. Bean
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INTRODUCTION

This study of the use of logical models in political science is essentially an example of philosophical analysis. The goal is not to analyze in detail particular mathematical or game theory models, but rather to evaluate the use of logical models as a method for aiding in the investigation or analysis of political phenomena.

The justification for such a study is based upon the fact that models of one sort or another are being used in political science to an increasingly greater extent. On the other hand, there seems to be some doubt about what one can expect from the application of models to the sciences involving human problems and behavior. Although the ultimate justification for any scientific method is its ability to help in an understanding of the phenomena under investigation, an analysis of the method itself will indicate, at least partially, the potentiality of the method. For this reason the study undertaken here attempts to analyze the method utilizing logical models; an analysis placing primary emphasis upon the problems inherent in applying an abstract deductive system to the real world.

The evaluation of the method, however, depends upon a prior understanding of what is meant by a "model." In other words, the first step in the analysis involves the establishment of an acceptable definition. The fact that such a definition has not been established is evident to any serious student of the social sciences. Models have been defined as mental pictures or images,[1] protomathematical or speculative,[2] as a

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[1]Herman Meyer, "On the Heuristic Value of Scientific Models," _Philosophy of Science_, XVIII, No. 2 (April, 1951), p. 113. Fred W. Riggs, "International Relations as a Prismatic System," _The International System_, eds. Klaus Knorr and Sidney Verba (Princeton: Princeton University Press, 1961), p. 146.

[2]Ernest R. Hilgard and Daniel Lerner, "The Person: Subject and Object of Science and Policy," _The Policy Sciences_, eds. Daniel Lerner and Harold D. Lasswell (Stanford: Stanford University Press, 1951), pp. 30-36.

formalization which conceptually marks off a perceptual complex,[3] a systematic discussion of concepts, assumptions, and hypotheses connected with a research project,[4] a set of assumptions concerning normal behavior,[5] a set of symbols together with a set of rules,[6] miniature theoretical systems,[7] etc. In an attempt to alleviate some of the confusion surrounding the term "model" and in order to provide a starting point for further analysis, Chapter I will develop a working definition of a logical model.

The definition of logical models begins by making a distinction between two types of models---normative and logical. In order to guard against any misinterpretation of this distinction, it seems advisable at this point to say that the characteristics of the two types are not completely mutually exclusive. Although the two types do have essential differences, it is still true that the use of such normative concepts as "complete rational behavior" are found in both types.

In Chapter II the definition of logical models will be applied to various models in political science. It must be emphasized that no attempt will be made to provide an exhaustive list of the use of these models in political science. Instead, some examples will be selected from a few areas of the discipline, namely, international relations, Supreme Court behavior, legislative behavior, and the electoral process. It is assumed that examples of these particular models together with models of a more "general" nature (that is, models which are constructed

[3]Paul Meadows, "Models, Systems and Science," American Sociological Review, XXII, No. 1 (February, 1957), p. 4. Marion J. Levy, Jr., The Structure of Society (Princeton: Princeton University Press, 1952), p. 30.

[4]James M. Beshers, "Models and Theory Construction," American Sociological Review, XXII, No. 1 (February, 1957), p. 34.

[5]Harold and Margaret Sprout, "Environmental Factors in the Study of International Politics," The Journal of Conflict Resolution, I, No. 4 (December, 1957), pp. 314-15.

[6]Karl W. Deutsch, "Mechanism, Organism, and Society: Some Models in Natural and Social Science," Philosophy of Science, XVIII, No. 3 (July, 1951), p. 230.

[7]Harold Guetzkow, "Building Models About Small Groups," Approaches to the Study of Politics, ed. Roland Young (Evanston: Northwestern University Press, 1958), p. 281.

to be applicable to politics in general) will suffice as a foundation
for the philosophical analysis of logical models. Chapters I and II,
therefore, constitute a definition of logical models and a brief bib-
liographical statement.

In Chapters III through VI the four main characteristics of logi-
cal models are evaluated. Chapter III indicates the problems involved
in the use of logical models when the model is considered as a deduc-
tive system. Chapter IV analyzes the assumption of isomorphism of
structure between the model and reality, whereas Chapter V discusses
the abstract nature of logical models. The analysis in Chapter VI con-
cerning the relationship between testable hypotheses and logical models
borrows heavily from the three preceeding chapters since the potential
utility of the hypotheses is dependent upon the fact that they are de-
duced from a logical system which incorporates abstract terms and rela-
tionships.

Aside from Chapters I and II the general tone of the study is
rather critical. Although such is the case, it must _not_ be inferred
that the aim of the study is the attempt to prove the inapplicability
of logical models to the phenomena of political science. Rather, the
intent of this analysis is to state the limitations inherent in the use
of logical models and thereby indicate the boundaries within which
logical models may be used in a valid manner. Braithwaite's comment
is appropriate at this point since his attitude toward the use of models
is, in fact, the disposition that has governed this study. "The price
of the employment of models is eternal vigilance."[8]

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[8]Richard Bevan Braithwaite, Scientific Explanation (New York:
Harper and Bros., 1960), p. 93.

CHAPTER I

A DEFINITION OF LOGICAL MODELS

Distinctions are man-made, say the semanticists. There is no
"natural" level at which distinctions ought to be made. The
level is determined by the needs of the language user and by
resulting social usage. Therefore, arguments about what terms
should be applied to what referents are not settled by "deter-
mining truth" but only by convention.[1]

An examination of the literature in political science dealing with
methodological problems indicates that the term "model" is used to con-
vey a wide variety of meanings. This being the case, the best procedure
is to establish a definition of "logical models"; a definition that will
be free from ambiguity and consistently adhered to throughout the rest
of the study. Moreover, the definition must be useful, i.e., it must,
in some sense, be relevant to the ways in which the term "model" is
used in political science.

The requirements of clarity of meaning, consistency of use and
utility indicate that the definition of logical models as used in this
study will be difficult to formulate. Nevertheless, the attempt will
be made and the procedure will be to begin with an analysis of _norma-
tive_ models. This may appear, on the surface, to be a round-about pro-
cedure, but to know what is not meant by a "logical" model will undoubt-
edly help to set the limits of a meaningful and useful definition.

A normative model is used to designate ideal functions for a num-
ber of actual or possible institutions. The model indicates at what
points observed phenomena depart from the prescribed standards (ideal
functions). In other words a normative model has the effect of encour-
aging stress upon the ways in which the described institutions fall
short of successfully performing what would ideally be their function.[2]

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[1]Anatol Rapoport, _Fights, Games, and Debates_ (Ann Arbor: The
University of Michigan Press, 1961), p. 304.

[2]David Braybrook, "The Relevance of Norms to Political Descrip-
tion," _American Political Science Review_, VII, No. 4 (December, 1958),
pp. 996-97.

Max Weber has, undoubtedly, given the classical exposition of this type of model. The central aspect of Weber's methodology is his attempt to resolve what he considered to be the impasse between the natural sciences which use generalized theoretical categories (i.e., logical systems) and the sciences of human behavior, which, at the time of his writing, used mainly subjective categories. The logical aspect of the natural sciences was exemplified by their use of generalized theoretical categories which were integrated in logically articulated theoretical systems and it was Weber's goal to show how this logical characteristic of the natural sciences could be used in the social sciences.[3]

To achieve this goal Weber used what he called "ideal types" and it is this aspect of his methodology that is of main interest in this study.

An ideal type[4] is both abstract and normative. It is an abstraction in that it never fully encompasses all aspects of reality.

> It does not describe an individual course of action, but a "typical" one—it is a generalized rubric within which an indefinite number of particular cases may be classified.
> . . . The ideal type contains no particular statements of fact.[5]

Although the ideal type is an abstraction, it is, as Parsons says, "a particular kind of abstraction."[6] It is an abstraction that ". . . states the case where a normative or ideal pattern is perfectly complied with."[7]

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[3]Max Weber, The Theory of Social and Economic Organization, trans. A. M. Henderson and Talcott Parsons (New York: Oxford University Press, 1947), p. 10.

[4]"An ideal type is formed by the one-sided accentuation of one or more points of view and by the synthesis of a great many diffuse, discrete, more or less present and occasionally absent concrete individual phenomena, which are arranged according to those one-sidedly emphasized viewpoints into a unified analytic construct...." Max Weber, The Methodology of the Social Sciences, trans. Edward A. Shils and Henry A. Finch (Glencoe: The Free Press, 1949), p. 90.

[5]Weber, The Theory of Social and Economic Organization, p. 13. See also, Talcott Parsons, The Structure of Social Action (New York: McGraw-Hill Book Co., Inc., 1937), p. 90.

[6]Parsons makes this point in his introduction to Weber, The Theory of Social and Economic Organization, p. 12.

[7]Ibid.

A completely rational course of action, then, can be designated an ideal type. Such a course of action is an abstraction; that is, non-rational action and errors of judgment which do in fact exist in most, if not all, real-life activities, are excluded. It is normative in that an ideal is postulated, namely, pure rational behavior.[8]

Even though the ideal type is both abstract and normative, it is possible,[9] according to Weber, for the sociologist to use it in his study of real social situations and activities.

> The construction of a purely rational course of action...serves the sociologist as a type ('ideal type') which has the merit of <u>clear understandability and lack of ambiguity</u>. By comparison with this it is possible to understand the ways in which actual action is <u>influenced</u> by irrational factors of all sorts, such as ... [emotions] and errors, in that they account for the deviations from the line of conduct which would be expected on the hypothesis that the actors were purely rational.[10]

In other words, the ideal type is ". . . a <u>limiting</u> concept with which the real situation or action is <u>compared</u> and surveyed for the explication of certain of its significant components.[11]

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[8] "The ideal type as Weber used it ... does not describe a concrete course of action, but a normatively ideal course, assuming certain ends and modes of normative orientation as 'binding' on the actors." <u>Ibid</u>., p. 13.

[9] Weber's argument is, in fact, a bit stronger than this. Not only is it <u>possible</u> for the sociologist to use ideal types—in a sense, it is <u>necessary</u> that they be used. "For purposes of the causal <u>imputation</u> of empirical events, we need the rational, empirical-technical and logical constructions, which help us to answer the questions as to what a behavior pattern or thought pattern (e.g., a philosophical system) would be like if it possessed complete rational, empirical and logical 'correctness' and 'consistency.'" Weber, <u>The Methodology of the Social Sciences</u>, p. 42. Later in his analysis Weber states the necessary relationship between ideal constructs and exposition. "Our imagination can often dispense with explicit conceptual formulations as a means of <u>investigation</u>. But as regards exposition, to the extent that it wishes to be unambiguous, the use of precise formulations [ideal types] in the sphere of cultural analysis is in many cases absolutely necessary." <u>Ibid</u>., p. 94.

[10] Weber, <u>The Theory of Social and Economic Organization</u>, p. 92. Also: "Its function is the comparison with empirical reality in order to establish its divergences or similarities, to describe them with the <u>most unambiguously intelligible</u> concepts, and to understand and explain them causally." Weber, <u>The Methodology of the Social Sciences</u>, p. 43.

[11] Weber, <u>The Methodology of the Social Sciences</u>, p. 93.

Using Weber's ideal type as an example, one can conclude that a normative model is abstract (i.e., it is not a description of reality), that it is a logical analytic construct that postulates an ideal,[12] and that it attempts to provide "clear understanding and lack of ambiguity" concerning concepts (rational action, e.g.) that the investigator feels relevant to an analysis of empirical reality.

Because the model is not a description of reality, it cannot be said that it is an hypothesis. Nevertheless, such a model can offer guidance for the construction of hypotheses.[13] A normative model carries out this function by providing an ideal concept that can be com-pared with reality. If, for instance, the model postulates pure rational behavior and if divergencies are found between the model and reality, then one can hypothesize that these divergencies are a result of non-rational action.[14]

Although the discussion so far has been centered around Weber's use of normative models, it is certainly the case that other scholars have used this type of model. Ernest Barker, for example, in his Reflections on Government[15] approaches the study of democratic govern-ment with the use of a normative model.

It is Barker's contention that only under a democratic government can men freely and fully develop their human personality. The basis for this democracy, he says, cannot be the mere force of numbers.

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[12]The "ideal" of a normative model is not necessarily an ethical ideal. For example, a normative model can have as its ideal a pure-ly logical scheme of rational action without implying that such action ought to exist.

[13]Weber, The Methodology of the Social Sciences, p. 90.

[14]"It [the ideal type] has the significance of a purely ideal limiting concept with which the real situation or action is compared and surveyed for the explication of certain of its significant compo-nents." Ibid., p. 93.

[15]Ernest Barker, Reflections on Government (New York: Oxford University Press, 1942), chap. ii.

Therefore,

> the form of government we have to find is one which elicits and
> enlists—or at any rate is calculated to elicit and enlist, so
> far as is humanly possible[16]—the thought, the will, and the
> general capacity of every member.[17]

The basis for such a form of government is discussion.

Just as Weber's models of rational behavior discussed human ac-
tivity assuming men were purely rational, in the same manner Barker's
model of democracy discusses the characteristics of democratic govern-
ment assuming each individual participates in the process.

The process of discussion, which was stated above as the basis for
democracy, leads to a compromise in which all ideas are reconciled and
which can be accepted by all "...because it bears the imprint of all."[18]
The compromise can bear the imprint of all only if discussion proceeds
in a number of stages[19] finally ending in a concrete decision.

The model is used to indicate what functions should be carried out
by each stage to insure that the end result will bear the imprint of
all; i.e., to insure that discussion is maintained throughout. In other
words, the function of the model is to indicate the divisions of labor
between the organs or institutions at the various stages. If each or-
gan operates ideally, discussion will be maintained and democracy will
exist in its best possible form.

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[16]Although Barker's model is one that is "humanly possible," it
can still be placed under the general rubric of normative models, as
that term has been defined above, because it postulates an abstract
ideal of government that enlists, for example, the general capacity of
every individual. Certainly, only in a very peculiar or theoretical
sense can one say that a government that enlists the general capacity
of every individual is "humanly possible."

The normative nature of the model is further exemplified in the
following statement. "A government depending on such a process [dis-
cussion] can enlist in itself and its own operation the self of every
member. It will be self-government: it will square with, and be based
upon, the development of personality and individuality in every self....
It will be a democracy which rests on the spiritual quality of the pro-
cess which it disengages and on the value of the process for every par-
ticipant." Ibid., p. 36.

[17]Ibid.

[18]Ibid.

[19]The four stages are party, electorate, parliament, and cabi-
net. Ibid., pp. 37-56.

Another explicit statement of the use of a normative model to discuss democracy can be found in Ranney and Kendall's <u>Democracy and the American Party System</u>.[20] The authors develop a model of democracy in order to provide an ideal with which actual governments and institutions can be compared.

> Our model of democracy will serve... to fix one end of a spectrum or scale,[21] along which we can place various existing institutions and governments.... [The model] will serve to fix one end of a spectrum, which , in turn, will enable us to measure the degrees of democracy of existing governments and institutions and to compare them with each other.[22]

The model, then, is a mental picture of a type or kind of government which includes only those characteristics[23] that distinguish it, for example, from monarchy or aristocracy.[24] Such an abstract limited model is necessary if one is to determine whether or not, or, to what extent an existing government is democratic. One cannot be concerned with <u>all</u> of the characteristics of existing governments—it is only possible to look at part of them; the part which seems to be essential to democracy. "But how do we decide which of its many parts to base our judgment on? There is only one possible answer: We decide in terms of a mental picture of the essential nature of democracy—in terms of a model of democracy."[25]

The authors state that this model can perform its function[26] only

[20]Austin Ranney and Willmoore Kendall, <u>Democracy and the American Party System</u> (New York: Harcourt, Brace and Co., 1956).

[21]After stating the four internal requirements of international systems (p. 123) Modelski states that his models of "agaria" and "industria" are ideal types. "...the models here introduced are presented as types marking two points along a continuum extending from primitive to industrial systems. They establish the standards with the help of which processes of change as intermediate structures may be appraised in relation to such a continuum." George Modelski, "Agaria and Industria Two Models of the International System, <u>The International System</u>, eds. Knorr and Verba, p. 124.

[22]Ranney and Kendall, <u>Democracy and the American Party System</u>, p. 21.

[23]These characteristics or principles are designated as popular sovereignty, political equality, popular consultation, and majority rule. <u>Ibid</u>., pp. 23-34.

[24]<u>Ibid</u>., p. 19.   [25]<u>Ibid</u>.

[26]The main function of the model has already been stated, viz.,

if two considerations are kept in mind. As an analytic device for the study of democratic governments it must be remembered that the model is a conception of the most democratic government possible, not necessarily a conception of the best government possible. Secondly, and more important for our purposes, the authors agree with Weber that this type of model "...is not identical with the 'historical compound' of traits found in any of the existing governments that are generally called 'democracies'."[27]

Now that the essential characteristics of normative models have been stated, the discussion can proceed to a definition of logical models. Although a logical model may have some of the characteristics of a normative model (the similarities between the two types will be noted below), one of its main distinguishing attributes is its use of the rules of logic (or mathematics) to manipulate the symbols or terms of the model. Models of this type usually make certain assumptions and then by the rules of logic attempt to deduce testable hypotheses. A logical model is not an attempt "to designate ideal functions for a number of actual or possible institutions," but rather, an attempt to use an abstract yet definite procedure (logic) as a means for arriving at a better understanding of the relationships between the variables of the political process.[28] The logic used to manipulate the terms, symbols or concepts of the model is deductive (as opposed to inductive).

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to provide a standard with which existing governments can be compared. On the basis of this comparison the model can have a very <u>practical</u> function. By visualizing an actual government as it would be if brought into conformity with the model, one is in a position to see what would have to be given up in order to make it conform. Then the question can be asked: "Are the gains provided by the advocates of democracy thus defined likely to be forthcoming, and, once they are achieved, are they likely to be worth the price?" <u>Ibid.</u>, pp. 55-56.

[27]<u>Ibid.</u>, p. 22. "The goal of the ideal-typical concept-construction is always to make clearly explicit <u>not</u> the class or average character but rather the unique individual character of cultural phenomena." Weber, <u>The Methodology of the Social Sciences</u>, p. 101. Emphasis added.

[28]This "better understanding" may be accomplished if a relationship can be found between the terms or symbols (and their relationships) of the model and the variables and their relationships in the real world.

Logical·models, like normative models, are abstract. The symbols or terms of the model do not pretend to describe or consider every aspect of reality. Downs, for example, in his statement about the individuals in his model says that

> ...we do not take into consideration the whole personality of each individual when we discuss what behavior is rational for him....he remains an abstraction from the real fullness of the human personality.[29]

The same point is made by Buchanan and Tullock when they explain that their models are based upon the assumption that the only meaningful decision-making units are well-informed, fully rational, utility maximizing, individuals.

> Yet we know that "groups" do exist as something apart from the individual members, that individuals are motivated by many considerations, and that individuals are far from being either well-informed or rational in their behavior.[30]

Once this important similarity is noted, any further analysis of the two types must, for the most part, be centered around their differences.

In the above discussion relating to normative models, the point was made that such models could lead to the formulation of hypotheses only by comparing the model with reality. In the case of logical models, however, the main attempt is to <u>deduce</u> the testable hypotheses from the initial assumptions.[31] This aspect of logical models is most explicitly formulated in Downs' <u>An Economic Theory of Democracy</u>. In fact, Chapter 16 contains a list of "testable hypotheses" derived from the various assumptions of the model.

Before analyzing in greater detail the unique characteristics of

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[29]Anthony Downs, <u>An Economic Theory of Democracy</u> (New York: Harper and Bros., 1957), p. 7.

[30]James M. Buchanan and Gordon Tullock, <u>The Calculus of Consent</u> (Ann Arbor: The University of Michigan Press, 1962), p. 297.

[31]This is not to say, however, that there is no continuous relationship between the model and reality whereby changes are made in the model because of discoveries in the empirical world. For a statement of this relationship see, Irwin D. F. Bross, <u>Design for Decision</u> (New York: The Macmillan Co., 1953), pp. 174-78.

logical models one further comment needs to be made concerning the relationship between normative and logical models. Max Weber, for example, points out that one of the merits of normative models is that they result in clear and unambiguous concepts that can be used in an analysis of social phenomena. Those who construct logical models also claim that their type, too, leads to a clear understanding, but whereas the normative models carry out this particular function by establishing unambiguous concepts or definitions, the logical type relies mostly upon uncovering hidden implications and underlying logical structures to help the political scientist, for example, to understand political events. According to M. A. Girshick and D. Lerner, models may

> ...enable us to interpret...empirical research data with reference to "underlying" logical and theoretical structures. They provide the meaningful context within which specific findings can be located as significant details. Models accomplish this, methodologically, by converting implicit assumptions into explicit postulates and hypotheses.[32]

An assumption that must be made in the construction of a logical model—an assumption that, for the most part, is not explicitly stated by political scientists using logical models and yet an assumption that is a central characteristic of such models—is that there exists an isomorphism of laws or structure between the model and the phenomenon for which it is a model.[33] In this sense, then, logical models as used in

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[32]M. A. Girshick and Daniel Lerner, "Model Construction in the Social Sciences—An Expository Discussion of Measurement and Prediction," Public Opinion Quarterly, XIV, No. 4 (Winter, 1950), p. 714. Emphasis added.

[33]This assumption of isomorphism is also noted by Hilgard and Lerner. "A model is an explicit statement of the structure which the scientist expects to find in any mass of data. The structuring of expectations is implied in any theoretical formulation. The construction of a model additionally requires that the structure be made explicit with reference to concrete 'sets' of data which it is intended to organize. Modeling thus becomes a method of genuinely integrating theory (a structure of expectations) and research (a mass of data) by means of explicit postulates and hypotheses." Hilgard and Lerner, The Policy Sciences: Recent Developments in Scope and Method, eds. Lerner and Lasswell, pp. 28-29.

One might also define model, not only as an example of an isomorphism between reality and a theoretical structure, but also as an isomorphism between two theories. "Two theories whose laws have the same forms are isomorphic or structurally similar to each other. If the laws of one theory have the same form as the laws of another theory, then one

this study correspond to what Richard E. Quandt calls isomorphic models. These models, he says, are designed "...for the purpose of inferring relationships within reality from relationships within the model. In other words, models derive their usefulness from their isomorphism to reality."[34]

Summary

Using the above discussion as a basis one can conclude that a logical model has four main characteristics.

A logical model is an example of a deductive system. It is a logical construct including certain assumptions or initial postulates from which conclusions are derived according to the rules of deductive logic.

Logical models are also characterized by the isomorphism of structure which is assumed to exist between the model and that aspect of reality for which it is a model.

Thirdly, logical models incorporate abstract terms or symbols, that is, the terms of the model do not have a one-to-one correspondence with empirical phenomena.

Lastly, a logical model is usually constructed for the primary purpose of deducing testable hypotheses. (It is possible, however, for a logical model to serve other functions, such as clarifying the implications of the assumptions or making explicit the logical relationships of the terms in the model).

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may be said to be a model for the other." May Brodbeck, "Models, Meaning, and Theories," Symposium on Sociological Theory, ed. Llewellyn Gross (Evanston: Row, Peterson and Co., 1959), p. 379.

[34]Richard E. Quandt, "On the Use of Game Models in Theories of International Relations," The International System, eds. Knorr and Verba, p. 71. Quandt makes a distinction between isomorphic models and metamodels. The latter, he says, are built "...for the purpose of clearing one's thoughts in some broad sense and discovering [for example] the essence of games which is inherent in the structure of the rules of a game without depending in any obvious way on the particulars of the situation." Ibid., p. 70. This distinction between isomorphic and metamodels is a result of designating two functions of models. Logical models can serve both functions and for the purposes of this study it is not necessary to establish two types of logical models to carry out these two functions.

In the following chapter specific examples of logical models will be discussed and it will be shown how these specific models entail the four characteristics mentioned above. As a prelude to this discussion, however, it is perhaps best to present at this point at least a skeletal outline of a logical model as it relates to the real world.

Like every thought or construct of the human mind, a model must begin with the knowledge or facts at hand. This means that the construction of a model begins with one's perception of the data which is considered relevant to the problem to be studied. The real world situation (for example, the behavior of American political parties and electorate) is then simplified and may be stated in a symbolic form $(x + y = z)$. This simplification of the real world situation constitutes the model. The terms or symbols of the model are then manipulated according to the rules of deductive logic which results in predictions or explanations relevant to the real world.

The data of the real world (or perhaps more accurately, one's perception of the data of the real world) plays a role in every aspect of logical model building--excluding, of course, that aspect concerned with the <u>logical</u> manipulation of the terms or symbols. The data of the real world provides the basis for the type of model to be constructed. Secondly, one's perception of the <u>relevant</u> aspects of the real world situation under investigation determines the parameters and values of the terms in the model. Lastly, the data of the real world must be used to evaluate the conclusions of the model.

Although a logical model is a deductive system incorporating abstract or simplistic terms or concepts, its connection with the real world is continuous and determines to a great extent the nature of the model.

CHAPTER II

EXAMPLES OF LOGICAL MODELS IN POLITICAL SCIENCE

Even a causal reader of current research literature gets the impression that the word "model" is one of the latest things in scientific language. The word is a roving beam that spotlights such various things as experimental design, postulate sets, deductive paradigms, theories, concepts, even language itself.[1]

To state the definition, however, is not necessarily the same as dispelling the confusion and ambiguity that surrounds the term "model" in political science. What is needed is the <u>acceptance</u> of a definition that will result in the same words having the same meaning--at least for one particular discipline.[2] It will become evident in the following discussion of the use of the term model that such an acceptance is necessary if the study of politics and social phenomena is to use concepts and methods that have the utmost utility. In other words, what is needed is an accepted definition that meets the standard of clarity-- "not only such clearness that the well-intentioned can understand but such clearness that the ill-intentioned cannot maintain that they fail to understand."[3]

It is true, of course, that other definitions of logical models could be given. The most important point to be made is that there is a need for political scientists to agree on a particular definition and the definition given above is stated with the conviction that it can fill this need.

Although logical models as defined above have been used in many

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[1]Meadows, <u>American Sociological Review</u>, XXII, No. 1, p. 3.

[2]Much of the literature cited throughout this study cannot, strictly speaking, be designated as falling within the confines of political science although the large part of it can be said to be a part of the social sciences in general.

[3]Lindsay Rogers, "Political Philosophy in the Twentieth Century: An Appraisal of its Contribution to the Study of Politics," <u>Approaches to the Study of Politics</u>, ed. Roland Young (Evanston: Northwestern University Press, 1958), p. 208.

areas of political science, their most extensive application has been in international relations. In part, this may be due to the complexity of this area of study which in turn demands some sort of a simplifying procedure, namely, the construction of models. This is the view expressed by Roger Hilsman when he says that

> the goal [of model building] is to create something the mind can handle, manipulate, and thus perceive otherwise obscured relationships in the form of hypotheses suitable for testing against the fullness of reality.[4]

On the other hand, there has been much confusion in international relations concerning the concept "model" and in the course of the following discussion the attempt will be made to alleviate, at least in part, this difficulty by suggesting that scholars keep in mind the distinction noted above between normative and logical models.

One of the earliest attempts to use models as a systematic and explicit method for the study of international relations is Morton A. Kaplan's, System and Process in International Politics.[5] Kaplan uses the term "model" to refer to "alternative possible international systems." After stating these models of the international system he wants "...to specify the environmental circumstances under which each system is likely to persist or the conditions under which it is likely to be transformed into one of the other systems."[6] These models, he says, are "hypothetical" and not meant to be totally realistic. Furthermore, many of the hypotheses of the model

> ...are intended to express the types of action which must characterize the system if it is to remain in equilibrium rather than to predict that any individual action will be of such a character.[7]

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[4]Roger Hilsman, "The Foreign-Policy Consensus: An Interim Research Report," The Journal of Conflict Resolution, III, No. 4 (December, 1959), n. 5, p. 364.

[5](New York: John Wiley and Sons, 1957). See also, K. E. Boulding, "Theoretical Systems and Political Realities: A Review of Morton A. Kaplan, System and Process in International Politics," The Journal of Conflict Resolution, II, No. 4 (December, 1958), pp. 329-34.

[6]Kaplan, System and Process, p. xiv. See also, Morton A. Kaplan, "Toward a Theory of International Politics: Quincy Wright's Study of International Relations and Some Recent Developments," The Journal of Conflict Resolution, II, No. 4 (December, 1958), p. 341.

[7]Kaplan, System and Process, p. 2. Emphasis added.

At another place he says that the international systems which are discussed are _heuristic_ models and, except for the balance of power system and the loose bipolar system, have never had any historical counterparts. And even these two systems are "unreal" in that the models do not include _all_ of the rules of behavior or causal variables that operate in their objective referents, i.e., in the actual balance of power and/or loose bipolar systems. The models may be unreal or simplified yet this simplicity means that the relations in the systems can be presented in a clear manner.[8]

This very brief statement of Kaplan's models does not pretend to exhaust the complexity of his analysis or to do justice to the insights that may be gained from the use of his models. For the purpose of this study, however, enough has been said to indicate that this type of model does not fall under the rubric of logical model, but rather satisfies the definition of a normative model. His discussion of the various systems is an attempt to indicate the crucial characteristics of each with the end result being an ideal of a logically extreme picture of a balance of power system, loose bipolar system, and so on.

Although Kaplan does not use the normative-logical classification of models suggested in this study, it is possible to analyze his discussion in terms of such a classification. On the other hand, there are examples of scholars using the term "model" in such diverse manners that all attempts of classification break down. The following discussion of Singer's article[9] is a case in point.

Confusion first arises in this article when model is equated with scheme[10] _and_ theory.[11] Here are three different words: model, scheme, and theory and in the interest of clarity or rigorous thinking it would seem that a distinction should be made among them. But perhaps this is just a sematic problem that deserves only passing notice before going on to more crucial problems.

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[8]_Ibid._, pp. 21-22.

[9]J. David Singer, "The Level-of-Analysis Problem in International Relations," _The International System_, eds., Knorr and Verba, pp. 77-92.

[10]_Ibid._, p. 78.   [11]_Ibid._, p. 79.

In his discussion of the requirements of an "analytical" model, Singer says that the model should

> ...offer a highly accurate <u>description</u> of the phenomena under consideration. Therefore the scheme must present as complete and undistorted a picture of these phenomena as is possible; it must correlate with objective reality and coincide with our empirical referents to the highest possible degree.[12]

Can one conclude from this statement anything other than the fact that Singer has equated "model" with a "statement of reality?" And if this is the case, then why use the term model?

Not only must the model describe reality; it must also have

> ...a capacity to <u>explain</u> the relationships among the phenomena under investigation. Here our concern is not so much with accuracy of description as with validity of explanation. Our model must have such analytical capabilities as to treat the causal relationships in a fashion which is not only valid and thorough, but parsimonious....[13]

Singer at this point is arguing for a conceptual scheme in which the relationship between the variables of the real world can be stated; or in other words, the model must have the ability to explain reality as well as to describe it. The type of explanation that Singer requires of a model is what is known as functional or teleological explanation. In explaining reality the model must state the role or function that a variable(s) plays in bringing about some goal or situation.[14]

One more requirement must be met by an analytic model according to Singer, i.e., the model must lead to "reliable predictions."[15] Prediction, he says, is <u>not</u> as demanding as explanation.

> ...we can predict with impressive reliability that any nation will respond to military attack in kind, but a description and understanding of the processes and factors leading to such a response are considerably more elusive, despite the gross simplicity of the acts themselves.[16]

Singer's requirements for an analytic model are in fact a summation of the <u>total</u> aims of any and all empirical research. The model must

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[12]<u>Ibid</u>., p. 78.   [13]<u>Ibid</u>., p. 79.

[14]Ernest Nagel, <u>The Structure of Science</u> (New York: Harcourt, Brace and World, Inc., 1961), pp. 23-24, 401-28.

[15]Singer, <u>The International System</u>, eds. Knorr and Verba, p. 79.

[16]<u>Ibid</u>., p. 80.

describe reality accurately, explain the relational characteristics of the real variables, and it must lead to reliable predictions. At the very least, "model" is being used here in a rather unique way that has little relevance to its usual usage in the discipline, and certainly, from other points of view, or considering other definitions, Singer's usage is incorrect.

In our analysis, then, of the use of logical models in international relations, two considerations must be kept in mind. First, a clear distinction must be maintained between logical models and normative models. Secondly, if the concept of model is employed, in either a logical or normative sense, a rigorous meaning must be given to it that distinguishes this concept from theory, scheme, hypotheses, research in general, and so on.

Instances of normative models in the area of the discipline are numerous but just a few will be mentioned in order to elucidate this type of model in international relations. Roger D. Masters, for example, uses Kaplan's six rules for a balance of power model as a starting point for his model of a multi-bloc system.[17] He refers to the initial statement of his model (and Kaplan's models) as an example of a "perfect" or "pure" model and also as being similar to Weber's "pure types."[18] The restatement of the model which removes three assumptions of the initial model[19] does not change the normative character of the model. This is clearly evident in Masters' statement that the model functions primarily as a method for analyzing the theoretical implications of regionalism (an example of a multi-bloc system)[20] and not as a means for deducing testable hypotheses about the real world.

Another explicit statement of a normative model can be found in Fred W. Riggs, "International Relations as a Prismatic System."[21]

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[17]Roger D. Masters, "A Multi-Bloc Model of the International System," American Political Science Review, LV, No. 4 (December, 1961), pp. 780-98.

[18]Ibid., p. 787. "The value of such models ["pure" or "perfect"] lies, ...not in their immediate descriptive virtues, but in their ability to indicate an underlying structure and thereby to suggest alternative modes of organizing the international system." Ibid.

[19]Ibid., p. 788.   [20]Ibid., p. 798.

[21]The International System, eds. Knorr and Verba, pp. 144-81.

According to Riggs, the traditional or usual approach to international relations is to use a model of the "inter-state system." This system is usually characterized by the absence of certain aspects of the individual states; for example, law enforcement. In effect this procedure of analysis, he says, results in the establishment of two ideal types, namely, the political order characteristic of the nation-state and an anarchic system of inter-state relations.

An approach to international relations based on this simple dichotomy leads to the conclusion that some (so-called) "states" (the Congo, e.g.) do not have the characteristics of states in the inter-state system.

Considering the limitations of the order-anarchic models, Riggs suggest that use be made of the "Prismatic Model." The model, he says, is a

> ...set of concepts and related hypotheses... [which he attempts to relate] to our contemporary international system in order to discover whether or not it might provide a fruitful alternative to the "inter-state" model as a way of thinking about the subject.[22]

He defines the prismatic model in the following way:

> I begin with a "functional-structural" approach--structures being defined as patterns of action; functions, as the consequences of such action for the system in which the action occurs. Accordingly, we may speak of a system for which a single structure performs all the necessary functions as a fused model, using the terminology of light. At the opposite end of this scale is a refracted society in which, for every function, a corresponding structure exists. Traditional agricultural and folk societies (Agraria) approximate the fused model, and modern industrial societies (Industria) approach the refracted model. The former is "functionally diffuse," the latter "functionally specific." Intermediate between these polar extremes is the prismatic model, so called because of the prism through which fused light passes to become refracted.[23]

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[22]Ibid., p. 148. Emphasis added. Riggs states what he considers to be five "functional requisites" for the survival of any society in an attempt to discover the characteristics of the structures that perform these functions in prismatic societies. This is done in order to see if the prismatic model is helpful to an understanding of the international system. Furthermore, "an analysis of the contemporary inter-state system might help us understand the underdeveloped country, and models for politics in these countries may illuminate aspects of international relations." Ibid.

[23]Ibid., p. 149.

Riggs, therefore, uses the prismatic model in somewhat the same manner as Ranney and Kendall, for example, employ their model of democracy. The prismatic model occupies a mid-point on a continuum whose extremes are the fused model and the refracted model. This prismatic model is then related to the real world in an effort to provide a framework for analyzing the international situation.

The approach which utilizes models along a continuum can also be found in George Modelski, "Agraria and Industria Two Models of the International System."[24]

> ...the models ... are presented as types marking two points along a continuum extending from primitive to industrial systems. They establish the standards with the help of which processes of change as intermediate structures may be appraised in relation to such a continuum. The models, moreover, are conceptual devices or constructs which draw upon and combine properties of international systems but do not in themselves necessarily represent any concrete international system. For this reason, no concrete international system is likely to be "pure" in the sense of embodying all characteristics of one model and no others.[25]

Turning now to logical models in international relations, the procedure will be to indicate briefly some examples of this type of model. Clearly, the most explicit statement of this type are the mathematical models and game models.[26]

In a sense, one could regard any mathematical statement as a model if the symbols of the mathematical statement are (or can be) identified with some empirical data. If such were the case, then the statement

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[24]The International System, eds. Knorr and Verba, pp. 118-43.

[25]Ibid., p. 124.

[26]It is important at this juncture to distinguish between game theory and game model; the former being the general framework in which the latter are constructed. Rapoport defines game theory in the following way which is sufficient for our purposes. "Game theory is an attempt to bring within the fold of rigorous deductive method those aspects of human behavior in which conflict and cooperation are conducted in the context of choice among alternatives whose range of outcomes is known to the fullest extent to the participants." Anatol Rapoport, "Critiques of Game Theory," Behavioral Science, IV, No. 1 (January, 1959), p. 65. Game models, on the other hand, refer to the actual examples of zero-sum two-person, zero-sum n-person, games.

would be a model for the data.[27] In keeping with one aim of this study, however, to provide a useful definition of logical models, it seems expedient to define mathematical models in a more rigorous manner so that the term does not refer to any or all mathematical statements having empirical referents.

Furthermore, a more exact definition can be attained that will also have the further advantage of indicating that this particular type[28] of model is a clear-cut example of a logical model; i.e., a mathematical model like a logical model can be characterized as being abstract, an attempt by the use of a deductive construct to uncover hidden conclusions, isomorphic and resulting in testable hypotheses.

James M. Beshers, for example, in his analysis of the way in which mathematical models are formulated states that

> mathematical models are constructed by _abstracting the properties of some data_ by measurement, and by expressing these properties in a set of symbolic statements that include the _logical relationships_ that hold for the entire set of statements.[29]

As this statement indicates, mathematical models are abstract _and_ are also concerned with analyzing or uncovering the logical relationships or structures within the model.

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[27]Stevens, for example, refers to a numerical series as an example of a mathematical model. S. S. Stevens, "On the Theory of Scales of Measurement," _Philosophy of Science_, eds., Arthur Danto and Sidney Morgenbesser (New York: Meridian Books, Inc., 1960), pp. 142-43.

[28]It is true, of course, that distinctions can be made between various types of mathematical models. Such distinctions are not crucial to the arguments presented in this study since the main concern is to analyze the two general types of models--normative and logical.

May Brodbeck, however, discusses three meanings that may be attached to "mathematical models," namely, any quantified empirical theory, any arithmetical representation of an empirical theory, and a formalization that lays bare the forms of the axioms of a theory by replacing all the descriptive terms by letters. Brodbeck, _Symposium on Sociological Theory_, ed., Gross, p. 392.

Hilgard and Lerner also distinguish between two types of mathematical models. The first type which uses the methods of _pure_ mathematics without any reference to empirical terms is called "analytical." The other type which employs equations whose terms are all amenable to direct empirical reference is called "empirical." Hilgard and Lerner, _The Policy Sciences Recent Developments in Scope and Method_, eds. Lerner and Laswell, p. 33.

[29]Beshers, _American Sociological Review_, XXII, No. 1, p. 38. Emphasis added.

That mathematical models and game models assume at least a degree of isomorphism between the model and reality can be easily demonstrated. S. S. Stevens, for example, argues that the utility of numerical scales or series for representing aspects of the empirical world implies that there is an isomorphism between the properties or relationships of the scale or series and the ways in which we can handle or manipulate empirical objects.[30]

Likewise, game models must also assume isomorphism[31] if the concepts employed in the models, such as information, strategy, conflict, utility, and rational behavior[32] are to be helpful in understanding the role of information, strategy, conflict, etc. in international relations.[33] Kaplan, for example, in System and Process[34] discusses the possibility of analyzing the question of whether or not to drop atomic bombs on Dien Bien Phu in terms of equations entailed in game models.

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[30]Stevens, Philosophy of Science, eds. Danto and Morgenbesser, p. 143.

[31]Richard E. Quandt formulates a two-fold typology of game models in international relations. These two types are called isomorphic models and metamodels and he argues that the latter are used "... (1) to test particular hypotheses about models, and (2) to enlarge the catalogues of possible outcomes and strategies." Richard E. Quandt, "On the Use of Game Models in Theories of International Relations," The International System, eds., Knorr and Verba, p. 76.
Metamodels, then, are models about classes of games (Ibid., p. 71) and assume no isomorphism with reality. It would seem, however, that even metamodels must assume a structural similarity between the game and the international situation if the former is to be useful in analyzing or understanding the latter.

[32]"Games are analyzed because the pattern of rational behavior that they exhibit is the same as that manifested in social action, insofar as the latter does in fact involve rationality." Abraham Kaplan, "Mathematics and Social Analysis," Readings in Game Theory and Political Behavior, ed. Martin Shubik (Garden City: Doubleday and Company, 1954), p. 12. Emphasis added.

[33]"Empirically the approach of the theory of games is based on the existence of far-reaching similarities between certain conventionally standardized games and certain recurrent social situations. Where such similarities exist, it is held to be more profitable to analyze first the games rather than the far less sharply defined social situations." Karl W. Deutsch, "International Politics and Game Theory," Readings in Game Theory and Political Behavior, ed. Shubik, p. 48. Emphasis added.

[34]Pp. 208-13.

Certainly, if the manipulations of the terms or symbols of the model are to say anything about the real questions concerning Dien Bien Phu then the assumption must be made that there exists a structural similarity between the equations and _the relations_ between crucial factors involved in the real problem (in this case, the crucial factors are: the states of the world, bomb, utility, gain North Viet Nam, etc.).

Many examples of mathematical models and game models can also be characterized as attempts to arrive at testable hypotheses.[35] In fact, mathematical analysis in general, i.e., the application of mathematics to empirical phenomena can be seen as a method that, once a problem has been defined, allows the theorist to manipulate the terms or concepts without reference to their empirical content as long as the rules of mathematics or logic are observed. The results or conclusions of such manipulations can then be empirically tested and if the data substantiates the conclusion then the analysis has proved useful in that context. A mathematical model, then,

> ...is...a set of assumptions often referring to a highly idealized [abstract] situation, from which assumptions the relations to be observed are _derived_, to be compared with observations. Agreement with observations corroborates the model.[36]

Model builders in game theory also claim that the conclusions of the model can be predictive of the real world if the _influential_ factors (parameters) that determine the outcome are included.[37] The same

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[35]"Game theory assumes that the conflict or competition element in political elements can be measured with precision and that often results can be predicted." Richard C. Snyder, "Editors Forward," _Readings in Game Theory and Political Behavior_, ed. Shubik, p. ix.

[36]Anatol Rapoport, "Various Meaning of 'Theory'," _American Political Science Review_, LII, No. 4 (December, 1958), p. 976. "...a mathematical model is not a metaphor but a logical scheme. Its conclusions are not analogies drawn between apparently similar phenomena but deductions from a set of postulates. If the conclusions are manifestly false, so must the assumptions be. If the conclusions are true, the assumptions are corroborated...." Anatol Rapoport, "Remarks on 'Political Equilibrium' by Sen S. Nilson," _The Journal of Conflict Resolution_, III, No. 4 (December, 1959), p. 391.

[37]Martin Shubik, "Introduction to the Nature of Game Theory," _Readings in Game Theory and Political Behavior_, ed. Shubik, p. 10.
Most, if not all, of the authors quoted above in reference to game theory would maintain in various degrees that an important contribution of the game approach to international politics is the ability of such an approach to result in "clear thinking" about such concepts as

viewpoint is maintained by Kaplan[38] and also by Luce and Raiffa. The latter, for example, in their discussion of an article by Luce and Rogow[39] refer to the six conclusions derived from the model as "...in a form which is meaningful to a political scientist and they can be evaluated by him in the light of current...data."[40] They further state that "with refinements" (referred to above as influential variables or parameters) the model will become more complicated but at the same time "more subtle" conclusions should result.[41]

In the above analysis of mathematical and game models as examples of logical models, studies have been cited that indicate the prevelence of this type in international relations. However, before moving on to discuss logical models in other areas of the discipline, at least brief mention should be made of a few more examples.

Highly developed mathematical models in the general area of international relations can be found in Lewis F. Richardson, Arms and Insecurity: A Mathematical Study of the Causes and Origins of War.[42] An extensive bibliographical statement of the mathematical approach to the study of politics is contained in Richard R. Fagen's essay, "Some

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conflict, cooperation, rational behavior, etc. In this sense, then, game models may be thought of has having one of the same characteristics of normative models, i.e., providing "clear understanding and lack of ambiguity" concerning concepts that the investigator feels relevant to an analysis of empirical reality.

This "normative" aspect of logical models (i.e., the use of normative or ideal concepts in logical models) will be discussed fully in chapter v.

[38]Kaplan, System and Process, pp. 184-87.

[39]R. D. Luce and A. A. Rogow, "A Game Theoretical Analysis of Congressional Power Distributions for a Stable Two-party System," Behavioral Science, I, No. 2 (April, 1956), pp. 83-95.

[40]R. Duncan Luce and Howard Raiffa, Games and Decisions (New York: John Wiley and Sons, Inc., 1957), p. 258.

[41]Ibid., pp. 258-59.

[42]Eds. Nicolas Rashevsky and Ernest Trucco (Pittsburgh: Boxwood Press, 1960). See also, Richardson, Statistics of Deadly Quarrels, eds., Quincy Wright and C. C. Lienau (Pittsburgh: Boxwood Press, 1960). For a summary of Richardson's arms-race model see Rapoport, The Journal of Conflict Resolution, III, No. 4, p. 329.

Contributions of Mathematical Reasoning to the Study of Politics."[43]

Of special relevance in accord with the established definition of logical models and their relationship to international relations is Thomas C. Schelling, The Strategy of Conflict[44] and Glenn H. Snyder, "Deterrence and Power."[45] Schelling argues that game theory, in general, has been too abstract and too preoccupied with the solution to the abstract nonzero-sum game and this emphasis has meant that "...game theory has not done justice to some typical game situations or game models and to the 'moves' that are peculiar to nonzero-sum games of strategy."[46] Therefore, Schelling argues that game models (i.e., game situations) should be constructed that epitimize, for example, the controversy over massive retaliation.[47]

He says that the strategy of the cold war and nuclear stalemate can be expressed in "game-type analogies," of which the following are examples:

> ...two enemies within reach of each other's poison arrows on opposite sides of a canyon, the poison so slow that either could shoot the other before he died, a shepard who has chased a wolf into a corner where it has no choice but to fight.... If we can analyze the structures of these games and develop a working acquaintance with standard models,[48] we may provide insights into real problems by the use of our theory.[49]

From what has been said already about logical models in international relations, a basis has been laid whereby Schelling's model (and

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[43]American Political Science Review, LV, No. 4 (December, 1961), pp. 888-900.

[44](Cambridge: Harvard University Press, 1960).

[45]The Journal of Conflict Resolution IV, No. 2 (June, 1960), pp. 163-78.

[46]Schelling, The Strategy of Conflict, p. 119. Emphasis added.

[47]Ibid.

[48]Undoubtedly, these "standard models" are what Quandt refers to as metamodels and in his article cited above he says that Schelling's use of metamodels is more insightful than attempts to use isomorphic models. The "...sometimes genuinely surprising insights that emerge from Schelling's analysis lend importance to the models, but primarily in their capacity as metamodels." Quandt, The International System, eds., Knorr and Verba, p. 72.

[49]Schelling, The Strategy of Conflict, p. 120.

other models as well) may be analyzed from two points. Firstly, to what extent are the models abstract attempts to uncover logical structures, isomorphic, and able to result in testable hypotheses? Secondly, the models might also be evaluated in reference to their use of normative concepts, i.e., to what extent do they attempt to provide insights into ideal situations such as nuclear stalemate, and so on?

Although mathematical models have been defined as examples of logical models, two qualifications must be kept in mind. The first has been mentioned in relation to game models, i.e., normative concepts may be included in such models. The second qualification is that mathematical analysis may be used solely for purposes of clarification and not as a means of deducing testable hypotheses. This aspect of mathematical analysis is evident in Glenn H. Snyder's essay, "Deterrence and Power."[50] The point is, that just because mathematics is used in research it is not necessary or even feasible to conclude that a model, either normative or logical, is being used.[51]

Snyder's article, in fact, is a study of the "logic of deterrence," and although he admits that deterrence cannot be exhaustively explained in terms of logic, he does contend that it is possible to express mathematically the relationships between the aggressor's calculus of net gains and/or losses and the deterrer's calculus of net gains and/or losses.

In practice, however, Snyder points out that the factors that must be considered in decision making (i.e., anticipation of net losses and gains) cannot be given precise numbers. What, then, is the value of such mathematical expressions or equations if the terms or symbols used have no exact empirical referents or content? Snyder's answer is that, for theoretical purposes, such analysis clarifies the logic or method by which the factors involved in decision making should be weighed or compared.

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[50]The Journal of Conflict Resolution, IV, No. 2 (June, 1960), pp. 163-78.

[51]Snyder uses the term "model" in his essay, but it (i.e., "model") seems to designate a hypothetical situation and none of the characteristics of "model" as defined in this study.

The logic, [he says,] is just as applicable to imprecise quantities as to precise ones; to express it in mathematical terms can provide a useful check on intuitive "judgment" and may bring to light factors and relationships which judgment would miss.[52]

Although it has been pointed out above that some examples of game models are so constructed that they meet the test of a logical model, it has also been stated that game models may in some instances be more clearly examples of normative models. The latter seems to be the case when game models and mathematical analysis have been applied to a study of the Supreme Court. A brief summary of Chapter IV of Glendon A. Shubert Quantitative Analysis of Judicial Behavior[53] will help substantiate this claim.

Shubert begins his defense of the use of game theory for political scientists by first admitting the limitations of this approach. Game theory, he says, often fails to consider social or political assumptions and furthermore the theory is static whereas the political and social processes are always changing. Nevertheless,

> ...the crucial question for political scientists remains: are there circumstances in which the results of investigation of political behavior can be compared with game models, leading to insights that could not otherwise have been obtained? If we assume, for instance, that the decision-making of judges is not completely rational, can we utilize game models as a measure of the extent to which judges depart from rationality in their decisions?[54]

If one compares this statement with the analysis of normative models given above the similarities become evident. Shubert does not argue that one can deduce testable hypotheses from the model but rather that one compares reality with the model to obtain otherwise unobtainable insights.

And just as Weber attributed deviation in the real world from the ideal type (of rational action, e.g.) to "emotion" and "error"; in the

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[52]Snyder, The Journal of Conflict Resolution, IV, No. 2, n. 2. p. 168.

[53](Glencoe: The Free Press, 1959).

[54]Ibid., p. 176.

same manner Shubert attributes the behavior of the Court that is not comparable to the best (i.e., most rational) strategy to "...various kinds of personality disorders...on the part of the individual justices who together define the group personality."[55]

When we turn our attention to the use of models in legislative behavior and election studies some rather explicit examples of logical models appear. Duncan MacRae, for example, in his well-known study of the House of Representatives in the 81st Congress[56] constructs a logical model in order to determine to what extent testable hypotheses can be deduced from an abstract mathematical framework or set of postulates.

The model, he says, deals "...with relations between a highly ab-stract constituency and an equally abstract legislator,"[57] and assumes (a) a set of individuals making choices and (b) that the individuals act to maximize rewards. Another abstract characteristic of the model is evidenced by the fact that the choices made by the individuals in the model are made in terms of positions along a single continuum or dimension. Realizing the unreality or abstractness of such a notion, MacRae justifies its use by pointing out that firstly, the notion does have some relation to actual political situations. Secondly, by considering only a single dimension one can limit the number of unwarranted assumptions while at the same time indicating the utility of a model based on such a notion.[58]

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[55]Ibid., p. 200. For examples of the use of mathematical analysis concerning the Supreme Court see: Fred Kort, "Predicting Supreme Court Decisions Mathematically: A Quantitative Analysis of the 'Right to Counsel' Cases," American Political Science Review, LI, No. 1 (March, 1957), pp. 1-12; Franklin M. Fisher, "The Mathematical Analysis of Supreme Court Decisions: The Use and Abuse of Quantitative Methods," American Political Science Review, LII, No. 2 (June, 1958), pp. 321-38.

[56]Dimensions of Congressional Voting (Berkeley: University of California Press, 1958).

[57]Ibid., p. 354. Emphasis added.

[58]In reference to this concept in model building which utilizes the unreal assumption of a one line continuum or uni-dimensionality of space, see Donald E. Stokes, "Spatial Models of Party Competition," Prepared for delivery at the 58th Annual Meeting of The American Political Science Association, Washington, D. C., September 5-8, 1962.

The utility of the model can be seen as threefold. In the first
place the conclusions of the model, even if they are not substantiated
by the relevant data can indicate possible new areas of research.[59] In
other words, even if a deduction (that A causes B, e.g.) is _empirically_
false it will serve the function of indicating that perhaps C or D
causes B. Secondly, to the extent that conclusions derived from as-
sumptions in the model are supported by observations some support is
given to these assumptions.[60] Lastly, because the model postulates cer-
tain _relations_ between the variables, it is possible that the model may
suggest explanations concerning these variables and their relationships
that would not be evident otherwise.[61]

A rather recent example of a type of logical model applicable to
the analysis of voting and electoral systems is evident in the use of
computer simulation. That computer simulation fits the above defined
concept of logical model can be shown by a brief analysis of "The Simul-
matics Project" by Pool and Abelson.[62] In this article the authors
state that computer simulation was used to indicate likely voter be-
havior.

> The immediate goal of the project was to estimate rapidly...the
> probable impact upon the public, and upon small strategically
> important groups within the public, of different issues which
> might arise or which might be used by the candidates.[63]

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[59]In fact, a model itself may be so constructed to be disproven.
If, for example, the problem to be studied concerns the presence or ab-
sence of restoring forces in party competition, and if a model of party
competition is constructed in such a way that it is historically or em-
pirically accurate _except_ that equilibrium (restoring) forces are omitted,
then the conclusions of the model when compared with reality indicate the
value of restoring forces to explain party competition, Donald E. Stokes
and Gudmund R. Iversen, "On the Existence of Forces Restoring Party Com-
petition," _The Public Opinion Quarterly_, XXVI, No. 2 (Summer, 1962), pp.
159-71.

[60]"What we shall do is to postulate reasonable utility functions
for choosers: if the conclusions derived from them are supported by ob-
servation, some inferential support is given to the postulates; if not
the postulates may be revised." MacRae, _Dimensions of Congressional Vot-
ing_, p. 357.

[61]_Ibid._, p. 368.

[62]Ithiel De Sola Pool and Robert Abelson, "The Simulmatics Pro-
ject," _The Public Opinion Quarterly_, XXV, No. 2 (Summer, 1961), pp. 167-83.

[63]_Ibid._, p. 167. See also, William N. McPhee, "Notes on a Campaign

The procedure was to use the available data about individual voters (collected from sample surveys) in order to develop matrices representing voter types and "issue clusters" and then to feed these matrices into a computer which, in effect, would simulate (i.e., act the same as) the voting attutudes and behavior of the voting public.

The authors also speak of

> ...creating synthetic, or simulated states....It was assumed that a voter of a given voter type would be identical regardless of the state from which he came. A simulated state therefore consisted of a weighted average of the behaviors of the voter types in that state, the weighing being proportioned to the number of such persons in that state.[64]

A siumlation, then, is that which for all intents and purposes functions the same as that for which it is a simulation; but it is not real, i.e., the computer, for example, merely siumlates the behavior of the real world (or a part of it).[65] In order to see more clearly the similarity between simulation and logical models one could picture the simulation of the computer as a logical model. It is evident that the computer uses the techniques of mathematics and logic to manipulate the terms or symbols. In this respect, then, simulation meets one of the requirements of a logical model.

This aspect of simulation involving logical manipulation is discussed by McPhee and Smith.[66] Like Pool and Abelson they begin not with generalized propositions, but with the detailed knowledge of how people vote in western democracies. Given this detailed knowledge they want to proceed from such knowledge to a general picture of how the whole system

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Simulator," _The Public Opinion Quarterly_, XXV, No. 2 (Summer, 1961), pp. 184-93.

[64]Pool and Abelson, _The Public Opinion Quarterly_, XXV, No. 2, p. 175.

[65]The reason or utility of computer simulation is that it makes it possible "...to reproduce...much of the complexity of a whole society going through processes of change, and to do so rapidly...." _Ibid._, p. 183.

[66]William N. McPhee and Robert B. Smith, "A Model For Analyzing Voting Systems," _Public Opinion and Congressional Elections_, eds. William N. McPhee and William A. Glaser (New York: The Free Press of Glencoe, 1962). For another statement and use of the same model see, William N. McPhee and Jack Ferguson, "Political Immunization," _Public Opinion and Congressional Elections_, eds. McPhee and Glaser, pp. 155-79.

(the electoral system in this case) works. The problem, therefore, in this type of a logical model, is not one of inferring the unobservables at the microscopic level from the total behavior or the system, but rather, to proceed "upward" from the observables at the microscopic levels to the unobservables at the systems level.

The method for arriving at the systems level from the level of individual behavior involves

> a simple model of individual voting behavior.... It [the model as incorporated into the computers] lends itself to rapid logical manipulation of sizeable numbers of units ("voters") arranged in complicated structures ("communities") through long sequences of processes ("eras" or "generations"). The manipulations are intended to help analyze problems in electoral dynamics of complexity too great to be easily understood——at first, and without such aids—— by more conventional verbal and mathematical methods.[67]

The abstract nature of simulation as a type of logical model is also easy to demonstrate. The "voters" that act in the simulation model are the results of sample surveys and the characteristics of these voters are limited to such factors as age, contact with certain other groups, sex, economic status and so on. In other words, the voters (in the electoral process, for example) do not include all voters in the actual process, nor are all of the attributes of even these selected voters designated. This is not to suggest that all voters and all of their characteristics be included in simulation models, but merely a statement of the reasons why such models are considered abstract.

The unreality of the assumptions, as Pool and Abelson point out, does not necessarily mean that models incorporating such assumptions

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[67] McPhee and Smith, *Public Opinion and Congressional Elections*, eds. McPhee and Glaser, pp. 124-25. Although this statement of the logical aspects of simulation seems reasonable, the same cannot be said of the following statement by McPhee and Smith. The construction of the aggregrate (i.e., the electoral *system*) is, they say, essentially a logical problem "...since the aggregrate syntheses [are] ...nothing but consequences of what is known from direct observation.... It is a problem in 'social logic,' that is, combining large numbers of small units in long sequences of interacting processes to determine their aggregate and cumulative consequences. The dynamic behavior of the latter is the known in the problem, even though it consists of logical consequences of what is known or assumed about individuals." *Ibid.*, p. 124. Emphasis added. The question is: How can one logically deduce the behavior of groups (aggregates) or processes from the behavior of individuals?

have no utility. As far as the model is concerned as a tool of research the interesting question is: Do models incorporating such unreal or partly true assumptions lead to conclusions that compare favorably to reality?[68]

From what has been said above, we can conclude that simulation is an example of a logical model. Simulation techniques use mathematics and logic to manipulate the terms or symbols of the model, incorporate abstract notions or individuals and result in testable hypotheses or prediction. Simulation models also assume an isomorphism between the process carried out in the model and the actual process in the real world. McPhee and Smith, for example, refer to the model used in their study as intermediate between (1) a mathematical model which is quantitative and abstract and which uses a computer for the subsidiary role of fast calculation and (2) nonnumerical models in which there are no equations and the machine carries out certain processes. Their model, they claim, resembles the second type "...in that it has no abstract equations but rather models events in a very literal sense."[69] The inputs which are fed into the model (machine) is an attempt to analyze the general process of the electoral system -- the assumption being that the process carried out by the machine resembles or is similar to the actual electoral process.

So far the discussion has centered around instances of models that are constructed to be applicable to a specific area or problem. Mention has been made of logical models in international relations, Supreme Court behavior, legislative behavior, and electoral processes. However, not all logical models are meant to be applicable only to specific problems or areas of the discipline. Some models, according to those who construct them, are relevant to political science in a much more general sense. Models of this type ("general" models) attempt to construct a logical deductive system based on a few definitions and assumptions from which can be deduced testable hypotheses relevant to politics as a whole. Three examples of this type of logical model will be stated

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[68]Pool and Abelson, The Public Opinion Quarterly, XXV, No. 2, p. 176.

[69]McPhee and Smith, Public Opinion and Congressional Elections, eds. McPhee and Glaser, p. 126.

below in order to provide a basis for analyzing and evaluating logical models in political science. Since these general models will be referred to quite often in the remainder of the study, the assumptions and arguments of the models will be stated in detail. In subsequent chapters these assumptions and arguments will be evaluated. If the analysis is correct, then the evaluations made concerning these general models will likewise apply to other logical models of a more specific nature since the difference between the two types (specific and general) is solely a matter of scope.

Anthony Downs, in his book, An Economic Theory of Democracy, formulated a model of democracy in an attempt to establish "...a generalized yet realistic behavior rule for rational government similar to the rules traditionally used for rational consumers and producers...and to trace its implications."[70] The rule which is hypothesized is "...that democratic governments act rationally to maximize political support."[71]

The first main hypothesis is:

...parties in democratic politics are analogous to entrepreneurs in a profit-seeking economy. So as to attain their private ends, they formulate whatever policies they believe will gain the most votes, just as entrepreneurs produce whatever product they believe will gain the most profits for the same reason.[72]

The second major hypothesis is that "...citizens behave rationally in politics."[73]

In an attempt to establish or validate his "generalized behavior rule" and major hypotheses, Downs constructs a hypothetical model of democracy based upon many unrealistic assumptions. He admits the unreal characteristics of his model, but he says that this does not necessarily affect its usefulness because "theoretical models should be tested primarily by the accuracy of their predictions rather than by the reality of their assumptions."[74]

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[70] Downs, An Economic Theory of Democracy, p. 3.

[71] Ibid., p. 20. [72] Ibid., p. 295.

[73] Ibid., p. 296.

[74] Ibid., p. 21.

The hypothetical or unreal nature of the assumptions in the model is evident in his statement of what constitutes rational behavior in the model. One of the basic premises in the model is that there exist in human activity a type of ordering which results in patterns of human behavior. This ordering, he says, is rational, i.e., he assumes in the model that behavior is "...directed toward the achievement of conscious goals."[75] Rational action, therefore, becomes a matter of (1) determining what one's goals are, (2) deciding upon the best alternatives to attain these goals and (3) acting accordingly.

In order to narrow down the type of rational action pertinent to his model, Downs says that the whole personality of man will not be considered since the primary goal of the study is to analyze economic and political behavior. Rational behavior in the model, therefore, is defined only in terms of economic and political goals, and does not relate to psychological or ethical goals. Downs admits that psychological goals, for example, influence economic and political conditions in the real world. He excludes such factors from the model, however, because he is convinced that reliable predictions can be deduced without them.

The predictions derived from this general model concern _many_ aspects of democratic government, e.g., the behavior of party members, the influence of majority opinion, the behavior of parties in a two- or multi-party system, voter motivation, and so on. One can conclude therefore that Downs' model is an example of a general logical model -- a model that is abstract, uses the rules of traditional deductive logic to manipulate the terms or concepts in the model, and results in testable hypotheses that apply to various aspects of political phenomena.[76]

Another example of a general logical model[77] can be found in James M.

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[75]_Ibid._, p. 4.

[76]From what has been stated above concerning isomorphism it is evident that Downs' model, like all logical models, assumes an isomorphism between the structure of the model and reality. Further reference to isomorphism as a characteristic of logical models will be excluded in the remainder of this chapter but will be analyzed in detail in chapter iv.

[77]Two qualifications must be made in reference to this point. (1) Although the authors analyze the calculus of the individual faced with constitutional choice, this choice is _not_ applied to all possible constitutional issues that could be presented. (2) Although (as will be shown

Buchanan and Gordon Tullock, The Calculus of Consent.[78] Like Downs[79] the authors use the concepts developed in economic theory as the starting point for their study and state that the purpose of the book is "...to derive a preliminary theory of collective choice that is in some respect analogous to the orthodox economic theory of markets."[80]

The "collective choice" that is of primary interest to the authors is the constitutional choice which is defined as that decision which puts a dividing line between collective action and private action. This choice can be pictured if one imagines a group of people who must decide what sort of a constitution to adopt——a constitution being a statement of the institutions and decision making procedures that are to be operative in the society.

The method used to analyze this constitutional choice involves the construction of a logical model, which incorporates the following assumptions. As the authors emphasize, the assumption of "individualism" is of primary importance in the model. This assumption means that the individuals in the model are the only ultimate choice-makers. Since individuals are the only choice-makers, the decisions of the community (to adopt a particular constitution, e.g.) must also be explained in terms of this assumption of individualism. In other words, the model postulates

> ...a purely individualist conception of the collectivity. Collective action is viewed as the action of individuals when they choose to accomplish purposes collectively rather than individually....[81]

The concept of government in the model is defined as "...nothing more than the set of processes, the machine which allows such collective action to take place."[82] Reflecting on these assumptions about the individualism and the government in the model, one can conclude that the government is an artifact, i.e., something created by men and therefore

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below) the authors do construct a general model, they also construct other more specific models to handle particular aspects of the problem of constitutional choice.

[78](Ann Arbor: The University of Michigan Press, 1962).

[79]"Our model bears a definite relation to previous economic models of government..." Downs, An Economic Theory of Democracy, p. 20.

[80]Buchanan and Tullock, The Calculus of Consent, p. 17.

[81]Ibid., p. 13.   [82]Ibid.

something which can be changed by them.

The individuals in the model are assumed to have separate goals both in their private and social actions.[83]

Unanimity is established in the model as the ultimate criterion for discussing the establishment of an original constitution or improvements in an existing one. This standard is used because the authors are interested in examining decisions that affect each member of the community or social group.

The model also assumes the "individualist-economic or the utility-maximizing" explanation of behavior in the political process. From this assumption which merely means that the utility functions differ among different individuals one can only explain the characteristics of the decision-making process itself. However, in order to develop hypotheses about the **results** of political choice the model introduces another assumption, namely,

> ...that individuals will, on the average, choose "more" rather than "less" when confronted with the opportunity for choice in a political process, with "more" and "less" being defined in terms of measurable economic positions.[84]

Individuals in the model are also assumed to act rationally.

> ...the choosing individual can rank the alternatives of collective as well as of market [individual] choice and...this ranking will be transitive....The individual is assumed to be able to choose from among the alternative results of collective action that which stands highest in the rank order dictated by his own utility function.[85]

Like Downs' model, the one presented in this study also includes the element of uncertainty. Uncertainty exists in the model because the individual in the group has no way of knowing the final outcome when he votes and thereby makes his own contribution to the outcome.[86]

The ultimate defense for this general model and the numerous

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[83]**Ibid.**, p. 14.   [84]**Ibid.**, p. 29.   [85]**Ibid.**, p. 34.

[86]**Ibid.**, p. 37. Although this element of uncertainty would be a severe limitation against a theory of collective choice which attempted to analyze the results of individual behavior in isolated and unique collective choices, "...this limitation is reduced in significance to some extent when it is recognized that collective choice is a continuous process, with each unique decision representing only one link in a long-time chain of social action." **Ibid.**

"submodels" developed in the study must be empirical. If the models result in a better understanding of "real" phenomena then their use is justified. The authors maintain that one may deduce testable hypotheses from the model and to the extent that these hypotheses are validated by empirical testing, to that extent support is given to the assumptions from which they are derived.[87]

The final example of a general logical model to be presented in this Chapter is William H. Riker's model which is formulated in his book, The Theory of Political Coalitions.[88] The model can be designated as "general" in that Riker attempts to provide at least a basis for a "genuine political science"[89] and to apply the "principles" (deductions) of the model to world politics[90] and not just to one specific area or aspect of the discipline.

After indicating the advantages of model building (in the natural and social sciences), Riker concludes that "...the main hope for a genuine science of politics lies in the discovery and use of an adequate model of political behavior."[91] Since he is interested in contributing toward a genuine science of politics he proceeds to construct such a model.

The model is a model of political behavior or decision and he defines political decisions as authoritative decisions on allocations of value[92] which are for the most part decisions made by groups (as opposed to individuals) by a conscious (as opposed to a "quasi-mechanical") process. Since most political decisions are made by groups and since

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[87]Ibid., p. 29.

[88](New Haven, Yale University Press, 1962).   [89]Ibid., p. ix.
[90]Ibid., ch. x.

[91]Ibid., p. 7. He defines "model" in the following manner which is similar to the way in which the term has been defined in this study. "The essential feature of this [scientific] method is the creation of a theoretical construct that is a somewhat simplified version of what the real world to be described is believed to be like. This simplified version or model is a set of axioms...from which nonobvious general sentences can be deduced. These deduced propositions, when verified, become both an addition to the model and a description of nature." Ibid.

[92]As Riker admits, this definition of political decisions is borrowed from David Easton, The Political System (New York: Alfred A. Knopf, 1953). Ibid., p. 10.

decisions binding on the whole group may be instituted by only a part
(a subgroup) of the group, "...the greater part of the study of the au-
thoritative allocation of value is reduced to the study of coalitions."[93]

The model, therefore, is a model about coalition formulation based
on the theory of n-person games.[94] This model, he says, is "...suffi-
ciently descriptive and sufficiently unambiguous to occasion some hope
for a genuine science of politics."[95]

The theory of games, however, involves the concept of rationality
or rational behavior and the model builder, therefore, must state this
condition in such a way that it is not just a tautology, yet at the same
time is not open to the criticisms which result if one equates the scale
of individual utility with the scale of money.[96] Riker attempts to do
this by saying that the rational political man is the one who would
rather win than lose.[97]

> Given social situations within certain kinds of decision-making
> institutions (of which parlor games, the market, elections, and
> warfare are remarkable examples) and in which exist two alterna-
> tive courses of action with differing outcomes in money or suc-
> cess, some participants will choose the alternative leading to a
> larger payoff. Such choice is rational behavior and it will be
> accepted as definitive while the behavior of participants who do
> not so choose will not necessarily be so accepted.[98]

Another assumption of the model, besides this concept of rationality,
is the condition of zero-sum, that is, the utility functions of the win-
ners and losers cancel out. "The zero-sum condition is the requirement

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[93]Ibid., p. 12.

[94]An n-person game can be best defined in relation to a 2-person
game in which the latter involves only two participants (A and B or A and
B united against "nature") whereas the former constitutes a game in which
there are more than two participants. The n-person game is more relevant
to most actual political situations and is therefore used in the model
rather than the 2-person formula.

[95]Riker, The Theory of Political Coalitions, p. 13.

[96]Ibid., pp. 16-20.

[97]This definition also seems to be tautologous in that all win-
ning coalitions would have to be designated as examples of rational ac-
tion.

[98]Riker, The Theory of Political Coalitions, p. 20.

that the gains of the winners exactly equal in absolute amount the losses of the losers."[99] Riker is quick to point out that the zero-sum condition is in some sense not applicable to actual political situations (i.e., when there is _mutual_ gain -- which is often the case), yet he says that this condition is applicable to his study of politics since he is concerned with coalitions in which the winner takes all, as is the case, for example, in elections.

> By emphasis on winning what is often an indivisible prize, in these matters, as in games, the common imagination abstracts pure conflict for which the zero-sum model is entirely appropriate.[100]

From this model Riker then deduces certain principles which are translated into descriptive or empirical statements that are capable of verification in the real world.[101]

Summary

This Chapter has been, for the most part, an attempt to lay the foundation for an analysis of logical models in political science. In Chapter I logical models were defined as logical constructs using abstract or unreal terms or symbols from which testable hypotheses could be deduced. These models, it was stated, explicitly or implicitly assumed an isomorphism of structure between the model and the real world.

This definition of logical models was then applied to some areas in the discipline in order to indicate examples of logical models and show in a concrete way what constituted a logical model as opposed to a normative model or mathematical analysis in general.

Lastly, the Chapter concluded with three examples of logical models whose applicability was not limited to one aspect of the discipline.

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[99] _Ibid._, p. 28. Also see: Luce and Raiffa, _Games and Decisions_, p. 158, and Abraham Wald, "The Theory of Games," _Readings in Game Theory and Political Behavior_, ed. Shubik, pp. 33-49.

[100] Riker, _The Theory of Political Coalitions_, p. 31.

[101] This aspect of Riker's model which tests _not_ the deductions from the model itself, but rather the translation of these deductions into descriptive statements, is worthy of special notice and will be discussed in chapter vi. In terms of the distinctions made in the Introduction between models and theories, Riker is implying (quite correctly) that one can empirically test only theories derived from the model and not the model itself _nor_ logical deductions from the model.

These models will be examined in detail in the following Chapters; the contention being that the analysis which is relevant to these "general" logical models will be pertinent to logical model building as a method and also to particular examples of logical models of a more limited scope.

CHAPTER III

THE LOGICAL NATURE OF LOGICAL MODELS

Finding out about the world is hampered by bad logic just as success at chess is hampered by bad strategy and the feeding of an army is hampered by bad arithmetic. But the avoidance and correction of logical faults are not the discovering of new facts about the world.[1]

In the definition of a logical model formulated in the previous chapter, it was said that one of its characteristics is the incorporation of the rules of logic or mathematics. To be more specific, the rules of logic used in logical models are those of deduction. This being the case, a logical model as an exercise in deductive logic (as opposed to induction) claims that its premises provide conclusive evidence for the truth of its conclusion(s). (An inductive argument, on the other hand, claims only that its premises provide some evidence for its conclusion).

In the analysis, then, of logical models as deductive systems two questions arise. First, what sort of conclusions can be established concerning the nature of logical models given the fact that they are deductive models? Second, to what extent are the arguments presented in An Economic Theory of Democracy, The Calculus of Consent and The Theory of Political Coalitions valid deductive arguments? This chapter will be an attempt to answer these two questions.

In order to answer the former, it is necessary that the characteristics of a deductive system per se be set out. The system is such that the postulates or axioms and the definitions of the terms within the system are deducible and defined in relation to a few (the fewer, the better) assumptions. If the system is considered as including the initial assumptions then one must conclude that all of the terms or symbols as well

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[1]Gilbert Ryle, "Symposium: Why are the Calculuses of Logic and Arithmetic Applicable to Reality?," Logic and Reality, Aristotelian Society, Supplementary Volume XX (London: Harrison and Sons, Ltd., 1946), p. 24. Emphasis added.

as all of the postulates can be defined or proved only by circular or infinite regressive arguments. In other words, a deductive system is <u>self contained</u> and the definitions of the terms and the proofs of the postulates have meaning only within the system itself. This "self contained" nature of a deductive system means that the truth or falsity of the system is a consideration that is extra-systematic; that is, a consideration that is an external property of the system and not contained within the system itself. <u>If</u>, on the other hand, it is assumed that the initial axioms or assumptions are true and <u>if</u> it is assumed that the inferences from these initial assumptions are valid, then and only then may one say that the truth of the inferences necessarily follows. As will be discovered, these two "ifs" are of crucial significance in relation to logical models as examples of deductive systems.

A deductive system is also <u>consistent</u>. This means that it is not possible to find within the system two inferences or deductions from the initial assumptions that are contradictory. A system is proved inconsistent, then, if it can be shown that it is possible to deduce such inconsistent formulas. But the very fact that one cannot find such contradictions does <u>not</u> prove that the system is consistent, for the failure to discover them may merely mean that the investigator did not have the ingenuity or insight to discover them. To prove the system <u>consistent</u> one would have to establish the truth of all of the axioms. Since the deductions from the axioms are logical consequences of those axioms, and given the truth of the axioms, the deductions would be true also and, therefore, the system would be consistent.

Considering the above, the impossibility of proving the consistency of logical models in political science is evident. The proof is impossible because all of the models have as their axioms or initial assumptions "unreal" or abstract (i.e., not true) propositions. Nevertheless, it will be possible to prove the inconsistency of any model if it can be shown that it contains contradictory deductions.

Another characteristic of a deductive system is that propositions within the system are empirically supported not only by observations of their occurrences or of instances of propositions deduced from them,[2]

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[2]This line of argument is the one most used by those constructing logical models. Admitting the simplistic or abstract nature of the

but also by observations of instances of other propositions in the system. In other words, the direct evidence for any higher-level proposition (for example, the assumptions of the model) from which a proposition logically follows (for example, a conclusion of the model) is indirect evidence for that lower-level proposition,[3] i.e., in a deductive system if one asserts the reasonableness of belief (support) in the premise one also asserts, at least implicitly, a belief in the reasonableness (support) of its logical conclusion.[4]

In many of the cited instances of logical models, the so-called "testable hypotheses" deduced from the model were inferences from two or more higher-level postulates. Therefore, if the lower-level hypotheses (in this case the deduced testable hypotheses) are refuted then what is refuted is the conjunction of these two or more higher-level postulates, which is another way of saying that the logical consequence of the falsity of the lower-level hypotheses is that at least one of the higher-level postulates is false. On the other hand, because of the logical relationships that hold between the postulates within the system, any piece of empirical evidence for any part of the system tends to establish the whole of the system.

If the deductive system is considered "formalized" then the system can have the ability to arrive at "hidden" relations between the terms or

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assumptions of the model, the claim is made that empirical support for the logical deductions of these assumptions is likewise support for the assumptions. In other words, if A implies B and one has empirical support for B, then there also exists support for A.

[3]"Observed facts will be said to be indirect evidence for a hypothesis [proposition] p if they are direct evidence for a hypothesis q (or for a set of hypotheses q_1, q_2, etc.) from which p logically follows. A corollary of this definition is that if the observed facts are direct evidence for a set of hypotheses q_1, q_2 ... q_n, they are indirect evidence for any one of these hypotheses, since each logically follows from the set." Braithwaite, Scientific Explanation, p. 17.

[4]This type of assertion is also maintained by model builders. The argument usually runs as follows: Although it is true, for example, that all men do not act rationally or even that some men act completely rational, yet it is reasonable to assume that at least some men act rationally to some extent. Therefore, it is maintained, the logical conclusions derived from such reasonable assumptions are likewise reasonable.

symbols of the model.[5] Formalizing the system means that the definitions or concepts of the system are designated by abstract symbols, letters, or numbers. Such a procedure allows the investigator to see the logical relationships between the symbols of the model more easily than would be the case if the symbols were words having actual empirical referents and cognitive connotations. If, for example, the model were about the behavior of voters in a two-party system, then by the process of formalization one could substitute "A" for voters and "B" for political parties. Formalization is not <u>necessary</u> in order to arrive at hidden relationships between the variables,[6] but the process makes it more likely that unknown relations will become evident.

Formalization is carried out by Buchanan and Tullock, Riker and Downs (to a lesser extent than the other two) with the expressed intention of perceiving more clearly the relationships between the variables of the model. Buchanan and Tullock, for example, postulate four basic constitutional variables introduced by representative government. These variables are then formalized as X_1, X_2, X_3 and X_4 in an attempt to discuss their interrelationships more carefully than would be possible if the variables and their relationships were expressed verbally.[7] Riker also uses the technique of formalization in his discussion of strategy in coalition building. As he says, much of the formalization is stated within the Appendices, but the verbalization within the text is dependent upon the insights gained from the more formal statements of the model.[8]

The construction of a logical model, therefore, may result (and often does) in discovering new relationships between the terms or symbols of the model. The interesting question is "What is the significance of these discoveries?"

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[5]Theories, as well as models, may be formalized but the purpose is the same in both. The purpose of formalizing a theory is to enable the researcher to demonstrate or "see" the relationships between the propositions of the theory.

[6]Downs, for example, does not completely formalize his model of rational behavior in a two party system.

[7]Buchanan and Tullock, <u>The Calculus of Consent</u>, chap. xv, <u>passim</u>.

[8]Riker, <u>The Theory of Political Coalitions</u>, chap. vi, Appendices I and II.

One definite answer that can be made to this question is that the newly discovered relationships are _not_ necessarily true for the real world. In order to substantiate this argument it is not necessary to state what is "true for the real world"— in fact, it is perhaps impossible to do so. Nevertheless, it has been established that the inferences or conclusions of the model are necessarily true only if the initial axioms or assumptions are true. Since the construction of a logical model involves admittedly unreal assumptions then _logically_ it is impossible to arrive at empirically true insights or new relationships deduced from such assumptions. Of course, it is possible that one could _in fact_ arrive at empirically true deductions from admittedly false or unreal assumptions—or from intuition, revelation or bad dreams. The point is that empirically true statements may be derived in various unrelated manners _but_ in reference to the model as a logical, deductive system, deductions must be true only if the assumptions are empirically true and the deductions are valid. Since by definition the former condition is lacking in logical models one must conclude that the newly derived insights into the relationships between the variables or terms in the model are not necessarily true of the real world.

Although those constructing logical models in political science would not claim that the logical conclusions of models are _necessarily_ true for the real world, the claim is often made that the construction of a logical model leads to clarity of expression. If, for example, the problems to be discussed are (1) a behavior rule for democratic government (Downs), (2) the logical or rational basis for constitutional government (Buchanan and Tullock), and (3) the formulation of political coalitions (Riker), then the construction of logical models will result in the expression of these problems in a clear-cut manner. Models accomplish this by formulating the _essential_ factors or variables of the problems in a deductive system. In this way, only the (assumed) crucial aspects of the problem are considered and the statement of the problems within a logical framework means that the significance and influence of these aspects are clearly obvious.

In their arguments for the utility of mathematical models in the

social sciences, Herbert A. Simon[9] and Kenneth J. Arrow[10] maintain that such constructs can lead to clarity. Simon's position is that one can construct a mathematical model for a social or political problem by translating the concepts and propositions of a theory into the language of mathematics. When the known verifiable propositions of the theory are so translated one will undoubtedly arrive at a greater clarity concerning the concepts embedded in the theory and the relationships between the variables or terms.[11]

Arrow argues (quite correctly) that mathematical models are limited to the extent that they often cannot express the complexities of reality that, to a certain degree, are more adequately expressed by ordinary language. He goes on to say, however, that "...it must be insisted that the advantages are equally apparent and may frequently be worth a certain loss of realism."[12] Like Simon, one of the advantages he claims for model building is clarity.

Once again the question is raised, "What is the significance of this 'clarity' that is a result of logical model building?" To answer this question a distinction must be made between two types of "clarity." On the one hand, clarity may be considered in relation to concepts or ideas or, secondly, the clarity which is a result of logical model building may be evaluated in terms of the suitability of operational definitions.

The former sense of clarity will be called "privatism"[13] in that clarity in this sense is nothing more than an elucidation of the original

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[9]Herbert A. Simon, "Some Strategic Considerations in the Construction of Social Science Models," Mathematical Thinking in the Social Sciences, ed. Paul F. Lazarsfeld (Glencoe: The Free Press, 1954), pp. 388-415.

[10]Kenneth J. Arrow, "Mathematical Models in the Social Sciences," General Systems, eds. Ludwig Von Bertalanffy and Anatol Rapoport (Ann Arbor: Mental Health Research Institute University of Michigan, 1956), Vol. I, pp. 29-47.

[11]Simon, Mathematical Thinking in the Social Sciences, ed. Lazarsfeld, p. 390.

[12]Arrow, General Systems, eds. Bertalanffy and Rapoport, p. 30.

[13]Robert K. Merton, Social Theory and Social Structure (2d ed. rev.; Glencoe: The Free Press, 1957), p. 364. In defining privatism as a type of reductionism, Merton quotes William James. According to James this privatism is a "vicious abstractionism: a way of using concepts which may be thus described: We conceive a concrete situation by singling

abstraction (that is, the model) and does not have any necessary relationship with the real world. Because there is lacking a definite relationship between the concepts which are abstract and the real world, the clarity is a private affair, meaningful only to those concerned with clarifying the original abstraction.

The second type of clarity--the suitability of operational definitions--is not "private." If the model does, in fact, result in operational definitions (as opposed to abstract or simplistic definitions) then it is possible for researchers to arrive at some consensus concerning the empirical value of the clarity of expression resulting from the model. This would not be the case if the clarity is of the former type.

Because there is no necessary relationship between the two types of clarity, there is no guarantee that a model which results in the clarity of privatism, for example, would also result in the clarity of operational definitions. Therefore, the answer to the question concerning the significance of the clarity resulting from logical models must be of the same type as the answer to the previous question concerning the significance of the discovery of new relationships in model construction. If one remembers that the model is not a picture or statement of reality, but rather a set of logically connected postulates derived from unreal assumptions or premises, it becomes clear that the clarity of expression derived from model construction (privatism) does not necessarily refer to propositions about the real world (operational definitions). Instead, the clarity of expression refers to statements in the model which is another way of saying that model building may result only in clearly stated models.

Essentially, the above comments point out the difficulty of relating postulates or equations in a hypothetical model to the real world. It is entirely possible that the initial assumptions have left out crucial variables and therefore important influential data may be excluded.

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out some salient or important feature in it, and classing it under that; then instead of adding to its previous characters all the positive consequences which the new way of conceiving it may bring, we proceed to use our concept privately; reducing the originally rich phenomenon to the naked suggestions of that name abstractly taken, treating it as a case of 'nothing but' that concept, and acting as if all the other characters from out of which the concept is abstracted were expunged." William James, The Meaning of Truth: A Sequel to "Pragmatism" (New York: Longmans, Green, and Co., 1932), pp. 249-50, cited by Merton, Social Theory and Social Structure, n. 106, p. 364.

<u>To the extent that this is the case</u>, then the "clarity" derived from the
model is not clarity about reality but rather clarity about the existing
model.[14]

The models stated by Downs, Buchanan and Tullock, and Riker are ex-
amples of deductive systems and therefore susceptible to the limitations
stated above. Furthermore, as deductive systems the models must also
meet the test of consistency, i.e., it must not be possible to deduce or
infer contradictory conclusions or postulates within the system. In the
remainder of this chapter these three general models will be discussed in
light of the consistency criterion, but the criterion will be weakened
somewhat. For the most part, effort will be directed toward showing to
what extent the inferences or deductions logically follow from the stated
assumptions. In other words, the question to be answered is "Are the de-
ductions valid inferences from the assumptions?" This restatement of the
criterion is weaker than the original because although a conclusion may
not <u>logically</u> follow from a premise it is not always the case that such
an illogical deduction is necessarily the <u>contradictory</u> of the conclusion
that does logically follow from the identical assumption. The illogical
or invalid deduction may merely be more inclusive or exclusive than the
initial assumption warrants; but not necessarily a <u>denial</u> of the valid de-
duction. In order to provide a clear distinction between the two tests,
the original, strong test will be called the "consistency test," while
the weakened version will be designated as the "deducibility test."

Considering the model as a deductive system, a failure to meet the
consistency test is more detrimental <u>to the system</u> than a failure to meet
the deducibility test.[15] In cases where models fail to meet the first

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[14]The problem here is how much reality must be entailed within
the assumptions of the model in order for the inferences of the model to
be reasonable hypotheses of reality. This aspect of the study, namely, the
abstract nature of logical models and how this characteristic affects the
deductions of the model will be discussed in chapters iv, v, and vi.

[15]"An inconsistent deductive system is worthless, for all of its
formulas are provable as theorms, including those which are explicit de-
nials of others. When the undefined terms [of the formal system] are as-
signed meanings, these contradictory formulas become contradictory propo-
sitions, which cannot possibly all be true. And since they cannot be true,
they cannot serve as a systematization of knowledge--for knowledge is ex-
pressed in true propositions only." Irving M. Copi, <u>Symbolic Logic</u> (New
York: The Macmillan Co., 1954), p. 178.

test, this failure will be emphasized. If the model, on the other hand, meets the requirement of the consistency test, then the ability of the model to meet the deducibility test will be stressed.

An examination of Downs' model in reference to the consistency test reveals that it involves certain contradictions: that is, contradictory conclusions can be deduced from the axioms. As was pointed out above, the model contains the following two axioms of rational behavior. (1) Parties are rational in that they act to maximize votes in the same manner that entrepreneurs are rational in that they act to maximize profits. (2) Citizens are rational in the sense that they seek to maximize utility from government action, that is, as rational voters they must vote for the party which seems to favor their own best interest. Other crucial assumptions are: (3) The party in power (the government) has as its primary goal re-election, (4) the goal of the parties out of power is election, and (5) all decision-makers in the model (parties, individual citizens and interest groups) act in terms of self-interest.[16]

The lack of consistency in the model that can be deduced from these axioms is shown in the following example. Suppose that party A is running for office. In terms of axiom (1) the party will act to maximize support. Axiom (5) would also demand that the leaders of this party are motivated to gain office because of the income, prestige and power that they desire to acquire. If one adds a further (and plausible) supposition that an individual or group of individuals (an interest group, for example) agrees to support party A only on certain conditions, then in reference to axioms (1) and (4) party A must meet these conditions. Without going beyond the democratic limits or conditions of the model, it is very conceivable that these demands would not be congruous with the perceived self-interest of the party leaders. For example, party A may conceive the control of the farm program on the basis of 100% parity as being in its self-interest. Party A would want control over the program because party members "...act solely in order to attain the income, prestige, and power which come from being in office."[17] In order to have power the party must control. At

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[16]For a more complete statement of the structure of the model see, Downs, An Economic Theory of Democracy, pp. 11-31.

[17]Ibid., p. 28. Emphasis added.

the same time, however, a group may agree to support (vote for) party A only on the condition that they control the farm program to the extent that the parity is reduced to 50%. In such a situation party A would have to deny one of the two axioms. To accept the support of the group would be to deny axiom (5). However, if the party acts in accord with axiom (5) and retains control over the farm program then the party in this situation must deny axiom (1), that is, they must act irrationally in terms of maximizing support. In either case the conjunction of axioms (1) and (5) lead to contradictions, and therefore, the model fails to meet the consistency test.

Another inconsistency in the model can be deduced from axioms (1) and (2). This inconsistency is pointed out by Downs[18] and briefly discussed by Riker.[19] The existence of two parties in the model means that the ideologies of the parties will overlap.

> ...overlapping policies [is] a rational strategy in a two-party system. Therefore, in the middle of the scale where most voters are massed, each party scatters its policies on both sides of the mid-point. It attempts to make each voter in this area feel that it is centered right at his position. Naturally, this causes an enormous overlapping of moderate policies.[20]

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[18]Ibid., p. 136.

[19]Riker, The Theory of Political Coalitions, pp. 98-101.

[20]Downs, An Economic Theory of Democracy, p. 135. Although Downs makes this statement in reference to a two-party system, Riker makes the astounding claim that "...as he [Downs] points out, the overlap is even greater when there are more than two parties." Riker, The Theory of Political Coalitions, p. 98. Riker gives no indication where he thinks Downs makes or infers such a conclusion. This lack of documentation can be explained by the simple fact that Downs makes no such claim. In fact, Downs' position is just the opposite, i.e., according to Downs, the overlapping of policies is greater in a two-party system than in a multi-party system. Consider the following statements found in An Economic Theory of Democracy. "Thus it is likely that in multiparty systems, parties will strive to distinguish themselves ideologically from each other and maintain the purity of their positions; whereas in two-party systems, each party will try to resemble its opponent as closely as possible." (pp. 126-27). "No tendency toward imitation exists in a multiparty system; in fact, parties strive to accentuate ideological 'product differentiation' by maintaining purity of doctrine." (pp. 140-41).

This overlapping means that the policies will be ambiguous so that the parties can appeal to large groups of voters without necessarily alienating other groups which may be more to the right or left of the major population group. Therefore, in a two-party system rational behavior of a party will mean that the party's platform or policies will be ambiguous. Because of this ambiguity and overlapping, voters will vote on the basis of the candidate's personality or on some other non-issue basis. Furthermore, parties will encourage irrational behavior (voting on a non-issue basis) by the voters since it is in their best interest to do so. It is rational, therefore, for the parties to encourage irrational voting behavior.

> ...if a member of one set [voters, parties] can gain by impairing the ability of all the members of the other set to attain their goals, he will do so. This follows from our axiom that each man seeks his own good and to get it will sacrifice the good of others, if necessary.
> To put it more concretely, if any party believes it can increase its chances of gaining office by discouraging voters from being rational, its own rational course is to do so.[21]

According to Riker, these two axioms which demand rational behavior on the part of both the parties and the voters are in contradiction. They contradict one another because to act in accordance with one of them entails a denial of the other.

> Downs points out that parties have a powerful incentive to achieve complete ambiguity. Indeed, if they behave rationally, they must. Furthermore, voters have, as he points out, no adequate defense against rational behavior by parties. Nevertheless, he concludes that the model is "not necessarily contradictory" and speaks of the situation in which parties actually succeed in beclouding their policies as a "rationality crisis." From this I infer that he supposes parties will not always succeed in beclouding, even though under the axiom of rationality they must. Since he has imagined no constitutional reason why they might not succeed, I conclude that the only reason they might not is that they might not try. And this amounts to relaxing the requirement that all parties behave rationally.[22]

One can conclude, therefore, that axiom (2) which demands that rational voters act to maximize utility income from government action cannot be

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[21] Downs, An Economic Theory of Democracy, pp. 137-38. There is a limit, however, beyond which it would not be rational for the parties to encourage irrational voting behavior. Irrational voting behavior must not be encouraged to the extent that such behavior would destroy the political system. "Since parties have a stake in this system they are irrational if they encourage anything which might wreck it." Ibid., p. 138.

[22] Riker, The Theory of Political Coalitions, p. 99.

valid in a two-party system which obeys axiom (1) because in such a situation the voter is forced by the rational action of the parties to act not on the basis of possible or actual policy decisions, but rather on the basis of the personality appeal of the candidates, etc. Therefore, rational action of the parties in a two-party system results in non-rational action of voters.[23]

The existence of contradictions in Downs' model does not mean that the model has no utility for the study of politics or political concepts. Their existence does signify, however, that the model fails to meet the requirement of a logically consistent deductive system.

Although the Buchanan-Tullock model does not result in contradictions, it does fail to meet the deducibility test. In other words, the conclusions or inferences from the basic axioms are more inclusive than the axioms warrant. The model, which was briefly discussed in the previous chapter, is an attempt to analyze the basis of constitutional government. After the decision has been made by the community or population to have a constitution, the next problem is one of deciding upon the rules of decision-making within the constitutional framework. For example, the individuals must decide if binding decisions are to be made by one individual, a minority group, a majority of 51%, a majority of more than 51%, unanimous agreement, or a combination of these decision-making rules.

According to the assumptions of the model, the basis for deciding upon the various decision-making rules is a matter of evaluating external costs and decision-making costs. The external cost to any individual in the community is the cost to himself that he expects to endure as a result of the actions of other individuals in the community. The decision-making cost is the time and effort involved that is necessary for two or more people to agree on a single decision. According to Buchanan and Tullock, the rational, utility maximizing individuals in the model can determine the correct decision-making rule in particular instances by establishing a relationship between the external cost function and the decision-making cost function.

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[23]For discussions which attempt to alleviate this contradiction or "tension" between these two axioms see: Downs, An Economic Theory of Democracy, pp. 137-41, 160-62, and Riker, The Theory of Political Coalitions, pp. 99-100.

In order to relate these two _functions_ an additional factor must be considered; namely, the number of individuals involved in the decision-making process. Thus,

> ...the _external-costs function_...for the single individual with respect to a single acticity [is] the costs that he expects to endure as a result of the actions of others [related] to the number of individuals who are required to agree before a final political decision is taken for the group.[24]

The decision-making costs function, on the other hand is

> ...the present value of those costs that [a particular] individual is expected to incur while participating in the whole set of collective decisions defined by a single "activity."[25]

The significance of these two costs functions as they affect the rational individual in the model is summarized by Buchanan and Tullock in the following manner:

> By employing these two functions, each of which relates expected individual costs to the number of persons in a group required to agree before a decision is made for the group, we are able to discuss the individual's choice of rules. These may best be defined in terms of the proportion of the total group that is to be required to carry a decision. For a given activity the fully rational individual, at the time of constitutional choice, will try to choose that decision-making rule which will _minimize_ the present value of the expected costs that he must suffer. He will do so by minimizing the _sum_ of the expected external costs and the expected decision-making costs....
> [Therefore] the rational individual, at the stage of constitutional choice, confronts a calculus not unlike that which he must face in making his everyday economic choices. By agreeing to more inclusive rules, he is accepting the additional burden of decision-making in exchange for additional protection against adverse decisions.
> In moving in the opposing direction toward a less inclusive decision-making rule, the individual is trading some of his protection against external costs for a lowered cost of decision-making.[26]

Since the solution to this problem of determining the type of decision-making rule(s) is crucial to the authors' endeavor to explain the rationale of constitutional government, any discrepancy within this basic aspect of the general model is of utmost significance. The model does, in fact, contain discrepancies and its utility is therefore somewhat limited. In general, the limitations of the whole study stem from the fact that constitutional democracy, as a procedure for men to govern

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[24]Buchanan and Tullock, _The Calculus of Consent_, p. 64.

[25]_Ibid._, p. 69.   [26]_Ibid._, pp. 69-72.

themselves, cannot be explained adequately in terms of logical deductions from a utility maximizing hypothesis. "Adequately" is an ambiguous term but perhaps its meaning as used here can be made clearer in the following discussion.

On page 64 of The Calculus of Consent the statement is made that "...as the number of individuals required to agree increases, the expected costs will decrease." This is a statement in the model and its justification, therefore, must come from the model itself. The question then is: Why is it that the individuals in the model can expect costs to decrease because more of the individuals are required to make the decision?

On the basis of the model there seems to be no reason why individuals in the model can expect the costs to decrease. According to the assumptions of the model individuals act to maximize utility and just because more of these individuals are involved in the decision-making process does not logically lead one to suppose that external costs will decrease for any particular individual. In order to make such a deduction from the original assumptions of the model, one would have to add the further statement that when the decision-making group increases in size the individuals in that group perceive their self-interest in a different manner than would be the case if they were a member of a smaller decision-making group. Unless the individuals change their perception of their self-interest in relation to the size of the decision-making group, there is no reason for the individuals in the population outside the decision-making group to expect that their external costs will change because of the various sizes of the decision-making group.

Perhaps a specific example would be helpful in clarifying this point. Suppose the size of the decision-making group in the Third Reich is designated as "X" and the external costs in question are the expected costs as perceived by any individual Jew in Germany. If the decision-making group X is hostile to the Jews, can one logically deduce that because the group is increased to X+1 that any individual Jew can expect his external costs to decrease? It would seem that he could expect a decrease in expected costs only if the addition of that one extra member (or one hundred extra members) changed the attitudes and policies of the group. If one excludes an evaluation of the attitudes and influences of the added members then it is impossible logically to deduce from the original assumptions of the

model that any individual can expect costs to decrease because of the addition of more members to the decision-making group.

On the other hand, if the decision-making group X is _not_ hostile to the Jews, an increase in the size of the group to X+1 or any other increase short of unanimity may in fact change the attitudes and policies of the group so that it becomes hostile to the Jews. Therefore, an increase in the size of the group (as long as the group does not contain every member of the community) does not have any logically necessary connection with the expected external costs of members outside the group.

So far, the discussion has been concerned with the relationship between the size of the decision-making group and the expected external costs for _any_ _one_ individual outside the group. One might ask, however, if it is not true that according to the model expected external costs will decrease for the _total_ population if the decision-making group is increased in size. The answer to this question must be in the negative if one is limited to the original statement of the model. In order to determine whether or not external costs will decrease for the total population in relation to an increase in the decision-making group one would have to analyze each individual's expected external-cost function in relation to each numerically different decision-making group. That is, one would have to compare the sum total of every individual's expected costs if the decision-making group consisted of three members, for example, with the sum total of every individual's expected costs if the decision-making group consisted of four members, etc.

If one adds to this examination of the relationship between expected external costs and the size of the decision-making group the presumption that the individual "...is considered not to have a particular and distinguishable interest separate and apart from his fellows,"[27] then there seems to be no reason at all for favoring a large decision-making group over a smaller one. However, if this presumption is included then the individual in the model is no longer explicable solely in terms of an entity that chooses "more" rather than "less"--in fact, the individuals would agree on what constitutes "more" and "less."

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[27]_Ibid._, p. 78.

The utility maximizing hypotheis seems sufficient to justify the conclusion of the model that when unanimity is in effect expected costs will be zero. This is so because the outcome of every decision rests in the hands of each individual and since each acts to maximize his own utility there is no chance of any outcome being contrary to any individual's designation of "more." But if the decision-making group is less than unanimity, then, whether or not the expected external costs will be greater or less in reference to numerically different decision-making groups will depend on how each group (and each individual outside the group) designates "more."

Buchanan and Tullock also discuss expected external costs in connection with a situation in which any individual in the total population or community can make decisions that will bind the whole group. As the authors point out,[28] in such a situation it is "intuitively clear" that the individuals can expect a rise in external costs. Although it is "intuitively clear" that this would be the case in any real-life situation, it is not at all clear how one could make such a deduction (that external costs would rise) from the model itself. In other words, the crucial question at this point in the study concerns the relationship between expected costs and any individual decision-maker in the model. The authors state that the rational individual in the model will realize that in order to maximize his utility he will support only those decision rules (and one could reasonably assume, he will make only those decisions) that will not promote sectional, class, and group interests.[29] One could also assume that the individual will make only those decisions that will not support individual interests of a particular nature since the individual "...is considered not to have a particular and distinguishable interest separate and apart from his fellows."[30] In the model, therefore, there is no individual motivated in such a manner that even if he alone were to make decisions binding upon the whole group the rest of the individuals in the group could expect external costs to rise.

It is evident from the above discussion of the relationship between the size of the decision-making group and expected external costs that

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[28]Ibid., pp. 66-67. [29]Ibid., p. 78. [30]Ibid.

the model fails to meet the deducibility test. Although many of the inferences from the model seem intuitively reasonable or possible of empirical verification, they are **not** logically **necessary** deductions from the axioms of the model. The operations of actual democratic governments, for example, lend support to the assertion that a decision-making process involving many people in the community is less costly in terms of expected external costs than a decision-making process involving one or two or three men. But although such an assertion is credible in light of historical or empirical facts, it is not a logically consistent deduction from the model.

The examination of Riker's model, on the other hand, does not result in the inconsistencies mentioned above in reference to the models postulated by Downs and Buchanan and Tullock. To a certain degree this may be due to the fact that Riker's model has a much more limited scope than the other two. Although it is true that Riker attempts by the use of his model to provide at least a basis for a genuine political science, the main logical deductions from the model itself are only three in number and related solely to the formulation of political coalitions. The first deduction or principle (as he calls it) is the size principle. "This is the assertion that, with complete and perfect information, winning coalitions tend toward the minimal winning size."[31] The strategic principle is the second deduction.

> This is the assertion that, in systems or bodies in which the size principle is operative, participants in the final stages of coalition-formation...move toward a minimal winning coalition.[32]

The final principle concerns disequilibrium.

> This is the assertion that, in systems or bodies where the size and strategic principles are operative, the systems or bodies are themselves unstable. That is, they contain forces leading toward decision regardless of stakes and hence toward the elimination of participants.[33]

As Riker indicates, only the first is deducible from the n-person game model alone; the other two are deduced from the model in **conjunction with** the first.[34] Therefore, insofar as complete and perfect information

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[31]Riker, *The Theory of Political Coalitions*, p. 211.

[32]*Ibid.*   [33]*Ibid.*   [34]*Ibid.*, p. 212.

(a prerequisite for the first principle) is lacking, the empirical validity of all three principles is in doubt. Riker states rather early in his analysis of the size principle that he realizes that "in almost no situations in the natural world...do participants possess such extensive or certain information."[35] It is the greater value of this logical model as compared with the model constructed by Buchanan and Tullock that the deductions of the model still retain this unreal aspect, and no attempt is made to include more in the conclusions than is warranted by the original statement of the model.

One can conclude, therefore, that Riker's model meets the test of consistency and, as an example of a logically deductive system, is more valid than the models of Downs and Buchanan and Tullock. Of course, the evaluation of a model as a technique for studying political phenomena involves more than the question of its consistency. The other relevant aspects of the model, such as, its isomorphism of structure with reality, its use of abstract terms, and its testable hypotheses will be discussed in the following three chapters.

Summary

The argument contained in this Chapter concerns only one aspect or characteristic of a logical model, namely, its deductive nature. As a deductive system the model is self-contained and therefore the question of its truth is extra-systematic. Secondly, the model as a deductive system can be evaluated in terms of its ability to meet the tests of consistency and deducibility. The existence of contradictions or unwarranted deductions means that the model fails to meet these tests.

The inability of a model, however, to meet the consistency test does not mean that the model has no utility. On the other hand, the existence of a consistent deductive system does not necessarily mean that it has utility.[36] In other words, it makes good sense to keep separate the evaluation of the model in terms of logical criteria and

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[35]Ibid., p. 47.

[36]One could conceive of an infinite number of consistent deductive systems that have little or no utility in relation to current problems. It may be that all such systems have a potential utility for future problems, but to say that the system is consistent is not to say that it is useful.

the evaluation of the model in terms of its utility. In this Chapter the emphasis has been on the former and the evaluation of the models in terms of utility is reserved for the following chapters.

Although it seems reasonable to separate the questions of logical consistency and empirical utility, this is not to say that there is no connection between the two. It would seem obvious, for example, that a deductive system devoid of all logical consistency would have little, if any, utility. But a model such as Downs' that, to be sure, involves contradictions is still able, for example, to offer insights into the behavior of political parties in a two- or multi-party system. The same claim can be made in reference to the model postulated by Buchanan and Tullock. As will be pointed out later, the existence of unwarranted deductions in the general model does not mean that the model cannot provide insights into the principle of majority rule and the rationale of bicameral legislatures.

Conversely, the existence of a consistent system (Riker's model), as will be argued later, does not mean that all of the deductions are useful or accurate in their application to reality.

Although there is no necessary or absolute relationship between a consistent system and its utility or between an inconsistent system and its lack of utility, the analysis of a model in terms of its logical deductive nature can be significant. It would seem that the inconsistency in the Downs model shows, for example, the limitations of attempting to explain the behavior of parties in terms of a vote <u>maximizing</u> hypothesis. As Riker points out, a more adequate hypothesis would be based on the "size principle," i.e., that parties seek only to gain a <u>minimum</u> winning coalition instead of a maximum amount of support.[37]

Furthermore, the unwarranted deductions of the Buchanan-Tullock model lead to the suggestion that it is impossible to prove the rationality of constitutional government if rational behavior is defined as self-centered, utility maximizing, and that, therefore, a more inclusive basis must be found.

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[37]Riker, <u>The Theory of Political Coalitions</u>, p. 100.

CHAPTER IV

LOGICAL MODELS AND ISOMORPHISM

A model of something...is a physical or symbolic representation of that object, designed to incorporate or reproduce those features of the real object that the researcher deems significant for his research problem....The choice of essential aspects of the reality being modeled depends upon the purposes for which the model is being constructed....The important factor is that the components and variables being investigated through the model respond in a manner comparable to that of the behavior of the real system.[1]

The definition of a logical model stated in Chapter I included the assertion that the model assumes an isomorphism or similarity of structure between the model and reality. Although mathematical models and simulation techniques were cited in Chapter II as examples of the assumption of isomorphism, the purpose of this chapter is to examine in greater detail this isomorphic character of logical models. The examination will consist of three steps. At the outset a definition of the concept as used in this study will be established. Second, a more inclusive argument will be given to establish the claim that logical model builders do assume an isomorphism of structure between the model and reality. For the most part, the examples of general models will be used in this discussion. Lastly, the significance and implications of this assumption will be evaluated.

In a very strict technical sense the word "isomorphism" denotes more than is meant when a logical model is said to have a structure that is <u>similar</u> to the real world, or an aspect of the real world. W. Ross Ashby, for example, defines isomorphism as entailing strict <u>equality</u>.[2]

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[1]Richard E. Dawson, "Simulation in the Social Sciences," <u>Simulation in Social Science: Readings</u>, ed. Harold Guetzkow (Englewood Cliffs: Prentice-Hall, Inc., 1962), p. 3.

[2]<u>An Introduction to Cybernetics</u> (London: Chapman and Hall, Ltd., 1961), pp. 94-98.

The definition given for isomorphism defines "equality" in the strictest sense — it allows that two machines [for example] ... are "equal" only when they are so alike that an accidental interchange of them would be subsequently indetectable, at best by any test applied to their behaviors.[3]

Ashby designates another type of relationship which he calls "homomorphism." If one refers to the relationship between a model and reality, then a homomorphic relation would allow for more complexity in reality than is in the postulates of the model. A homomorphic relationship demands only that a similarity exists — it does not require equality. Since the construction of a logical model assumes only a similarity of structure between the model and reality, the correct technical term for this relationship would be homomorphism.

On the other hand, because those authors cited in this study (excluding Ashby) refer to the relationship as isomorphism this terminology will be used throughout. Therefore, when the statement is made that there exists an isomorphism of structure between the model and reality, the inference is not that the structures are identical but rather, that the structures are similar.[4]

Although one of the primary aims of this chapter is to study the isomorphic relation between a logical model and reality, a brief examination of isomorphism between two theories and between a model and theory will help clarify the essence of this relationship and thereby provide a more adequate basis for discussing the structural relationship between a model and reality.

Structural isomorphism may be said to exist between two theories if it is possible to interchange the empirical concepts of the two theories. It may be possible, for example, to use the same mathematical relationships or formulas to explain some particular aspect of physics and some phase of biology. If this is the case, then the substitution of the empirical concepts in the physics theory with those of biology will not change the structure (the system of relationships) of the theory.

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[3]Ibid., p. 102.

[4]According to Paul Meadows, isomorphism of model and reality is "rare indeed." American Sociological Review, XXII, No. 1, p. 8. In fact, from what has been said concerning the model as a logical deductive system and in light of the fact that the model uses abstract terms, a strict isomorphism seems impossible.

The structure of both theories will remain the same and one can conclude, therefore, that the two theories are isomorphic in structure.

An isomorphic relation can exist also between a theory and a model.[5] This relationship is explained by R. B. Braithwaite in terms of two deductive systems utilizing the same calculus. (A calculus is a formalization of a deductive system.) In the words of Braithwaite, "A representation of a deductive system in such a way that to each principle of deduction there corresponds a rule of symbolic manipulation will be called a calculus."[6] In such an instance where two systems employ the same calculus,

> a theory and a model for it, or a model and a theory for which it is a model, have the same formal structure, since theory and model are each represented by the same calculus. There is a one-one correlation between the propositions of the theory and those of the model; propositions which are logical consequences of propositions of the theory have correlates in the model which are logical consequences of the correlates in the model of these latter propositions in the theory, and vice versa. ...the similarity in formal structure...is all that is required of the relationship of model to theory.[7]

Although the situation becomes more complex when a model is related to reality, the same claim of structural isomorphism is asserted in this instance as it is in the two former cases. May Brodbeck, for example, in her discussion of testing models in the social sciences, states that one must first be able to state clearly what is in correspondence with what. If one uses the notion of organism as a model for society then one must be able to relate the "growth" which is characteristic of organisms to some aspect of society which also "grows."[8]

However, once the correspondence is established between the empirical concepts and the terms or symbols of the model, then the structural

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[5]According to May Brodbeck, the term "model" may be used to refer not only to the isomorphism between the laws of empirical theories, but also between the empirical theory and its arithmetical representation. "...the laws, or some of them, of an empirical theory may have the same form as a set of purely arithmetical truths. If this is the case, then the latter is called an arithmetical representation of the empirical theory." Symposium on Sociological Theory, ed. Gross, p. 383.

[6]Braithwaite, Scientific Explanation, p. 23.

[7]Ibid., pp. 90-93.

[8]Brodbeck, Symposium on Sociological Theory, ed. Gross, p. 380.

similarities are sought. In other words,

> ...not only must the terms of the two areas correspond, but the
> connections among these concepts must also be preserved, if the
> model is to be of any use. An area, either part or all of it,
> can be a fruitful model for another only if corresponding concepts
> can be found and if at least some of the laws connecting the con-
> cepts of the model also can be shown to connect their correspond-
> ing concepts.[9]

This same line of argument is upheld by Cohen and Negel.

> Whether anything in the world of existence conforms to [a hypo-
> thetico-deductive] system requires empirical knowledge. If this
> is the case, that portion of the actual world must have the sys-
> tematic character indicated formally in our symbolic representa-
> tion.[10]

Karl Deutsch, writing in the Philosophy of Science, states that a

model can aid in the prediction and/or control of reality only to the

extent that the patterns and laws of the model resemble an aspect of

reality.[11] The utility of the model, at least to some crucial extent,

is determined by its resemblence with the real world. This similarity

of the model with reality is ascertained by "...the degree of corre-

spondence between the structure proposed from the model and the struc-

ture derived from the outside facts."[12]

From the above statements of Braithwaite, Brodbeck, and Deutsch it

is evident that the construction of a useful or potentially useful model

involves an isomorphism of structure between the model and reality. Al-

though these scholars are writing in the general area of the philosophy

of science, those constructing models in political science also claim an

isomorphism between the model and reality. The remainder of this chapter

will be an examination of the general models of Downs, Buchanan and Tul-

lock, and Riker in reference to the assumption of isomorphism between the

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[9]Ibid.

[10]Morris R. Cohen and Ernest Nagel, "The Nature of a Logical or
Mathematical System," Readings in the Philosophy of Science, eds. Herbert
Feigl and May Brodbeck (New York: Appleton-Century-Crafts, Inc., 1953),
pp. 135-36.

[11]Deutsch, Philosophy of Science, XVIII, No. 3, p. 230.

[12]Ibid.   For further statements concerning structural similari-
ties between model and reality or a set of data see: Talcott Parsons,
"'Voting' and the Equilibrium of the American Political System," American
Voting Behavior, eds. Eugene Burdick and Arthur J. Brodbeck (Glencoe: The

models and those aspects of reality for which they are models.[13]

In a very real sense, an isomorphism between the model and reality must be assumed if the model is to say anything about the real world. In other words, a useful model must have some relationship with reality and an essential relationship will include a similarity of structure between the model and reality. Suppose, for example, as in the case of Downs' model, the problem to be studied is the relationship between rational voters and the multi-party system. It seems obvious that if the model is to explain anything about this situation then the relationship between the voter and the party system in the model must, in some essential sense, be similar to the relationship between actual voters and real multi-party systems. If the system or model is formalized then the symbolic relationships between the terms must have some correspondence with the relationship of the empirical referents of those terms.

To be more accurate, one further assumption must be made before one can expect conclusions with a possibility of empirical verification. One must assume that the terms or symbols as well as their relationships have empirical referents. In other words, a potentially useful model must have an isomorphism of structure with the real world and operational validity. (This aspect of logical model building will be discussed in the following chapter concerning the use of abstract terms in the model.)

The point has already been made that Donws' model, like every logical model, uses abstract terms. On the other hand, however, Downs claims that the model is realistic—at least to some extent. In his attempt to discover a rational form of political behavior for the government and citizens of a democracy he constructs "...a model which is realistic and yet does not fill in the details of the relationships within it."[14] It can be inferred from this statement that although all of the complexities of the relationships between voters and the multi-party system, for example, are not included in the model, yet at least

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Free Press, 1959), pp. 114-15; and, Levy, _The Structure of Society_, pp. 26-30.

[13]It is the contention of this study, however, that this assumption is made in the construction of _any and all_ logical models in political science.

[14]Downs, _An Economic Theory of Democracy_, p. 20.

some of the stated relationships in the model correspond to the real world.

This inference can be more firmly established by a closer examination of Downs' study of the role of party ideologies. In the model the assumption is made that political parties (in reference to their ideologies) can be placed on a continuum whose right and left extremes denote respectively the absence and total involvement of the government in the economy. Parties, therefore, are related to one another in reference to one single issue, namely, the degree of government intervention in the economy expoused by the parties. As Downs admits

> ...this apparatus [the placing of parties on a one-issue continuum] is unrealistic for the following two reasons: (1) actually each party is leftish on some issues and rightish on others, and (2) the parties designated as right wing extremists in the real world are for fascist control of the economy rather than free markets.[15]

However, Downs maintains that although this structure of the model is to some extent unrealistic, the model may still be useful for an understanding of the role of party ideologies in relation to the rational voter.

If one adds to the model the assumptions of a variable distribution of population, a relative ideological immobility of the parties, and definite political preferences for all voters, then the model results in the conclusions that parties in a two-party system converge ideologically and that the fear of losing extremist voters keeps the parties from becoming identical.[16] The former conclusion is included in the list of testable propositions derived from the model[17] and it seems reasonable to infer that if the structure in the model did not correspond to some extent with the real world logical deductions capable of empirical verification could not be derived.

The necessity of an isomorphism of structure between model and reality in order to arrive at empirically verifiable conclusions is also stated (indirectly) by Buchanan and Tullock. The model which incorporates the relationships among individuals and the size of decision-making groups will be insightful only if some essential aspect of reality conforms to these postulated relations. If, in fact, there is no correspondence

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[15]Ibid., p. 116.   [16]Ibid., p. 140.   [17]Ibid., p. 297.

between the relations postulated in the model and the actual relationship between individuals and the size of the decision-making group, then it would make little sense to suppose that such a model could lead to a better understanding of real political situations. In reference to this degree of correlation between the relationships in the model and reality the authors make the following statement:

> The model which incorporates this behavioral assumption [that individuals act to maximize utility] and the set of conceptually testable hypotheses that may be derived from the model can, at best, explain only one aspect of collective choice. Moreover, even if the model proves to be useful in explaining an important element of politics, it does not imply that all individuals act in accordance with the behavioral assumption made or that one individual acts in this way at all time. ...the theory of collective choice can explain only some undetermined fraction of collective action. However, so long as some part of all individual behavior in collective choice-making is, in fact, motivated by utility maximization, and so long as the identification of the individual with the group does not extend to the point of making all individual utility functions identical, an economic-individualistic model of political activity should be of some positive worth.[18]

A more explicit statement of the isomorphic relation between the model and reality can be inferred from the authors' discussion of representative government. Buchanan and Tullock point out that if their model of constitutional decision-making is to be applicable to the understanding of representative government (as opposed to pure democracy), then some additional variables must be introduced. These variables are interrelated and constitute four choices that must be faced by the individuals in the model if the government is to be based upon the principle of representation. First, a choice must be made concerning rules for choosing representatives. Second, rules for deciding issues in the legislature must be laid down. Third, the degree of representation must be established and, finally, a decision must be made concerning the basis for representation (functional, geographic).[19]

According to the analysis in Chapter 15 of The Calculus of Consent an "optimal" balance between the four variables can be established by employing the two original functions of external costs and decision-making costs. In other words, by translating the newly introduced

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[18]Buchanan and Tullock, The Calculus of Consent, p. 30. Emphasis added.

[19]Ibid., pp. 213-14.

variables into the terminology of the functions of external and decision-making costs one can arrive at the structure of representative government that would meet the approval of a rational, utility-maximizing individual.[20]

For the purpose of this aspect of the study it is not necessary to pursue the analysis developed in this representative model. The crucial question concerns the relationship between this model which postulates only four variables involved in the question of choosing among various types of political organizations and the real world in which, as the authors admit, many other variables must be considered. Not only do Buchanan and Tullock conclude that their simplified model has a structural similarity with the real world--they further contend that the traditional explanations of representative government that include many more variables unnecessarily complicate the central aspect of the problem. As the authors state:

> In the real world there are many constitutional-institutional variables which the individual must rationally consider when he is given the opportunity of reflecting on the prospects of alternative political organizations. However, if our purpose is the relatively limited one of analyzing the essential decision-making processes through which all constitutional choices must be made, the simplified construction that we have emphasized seems quite helpful. Perhaps the absence of such models in the literature of political science is to be explained, in part at least, by an overconcentration on the apparent complexities of real-world political processes.[21]

In the same manner in which Buchanan and Tullock analyze the "essential" aspect of constitutional decision-making by means of a "simplified" model, Riker attempts an analysis of a crucial or essential aspect of politics (the formulation of coalitions) by means of a model constructed around the condition of zero-sum. This condition

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[20] "At the outset the model may have appeared to be applicable only to direct democracy; but, because the other constitutional variables can be readily translated into the same functional variables [external and decision-making costs functions] , the basic analytical model can be employed as the general model for constitutional choice. We have shown that the four constitutional variables introduced by representative government can be reduced in form to a single model that embodies the two essential cost functions." Ibid., p. 230.

[21] Ibid., pp. 230-31.

...is the requirement that social situations be abstracted for study in such a way that only the direct conflicts among participants are included and common advantages are ignored.[22]

As Riker points out, this condition is not always evident in every political conflict--that is, in many cases there are mutual gains. Nevertheless, a model constructed on this zero-sum condition is applicable to an "essential" aspect of politics (elections and wars) and therefore related to at least some aspects of the real world.[23]

The assumption of isomorphism of structure between the model and reality is also evident in Riker's discussion of his model which postulates the condition of n-person as well as zero-sum.[24] In a theoretical sense, a model based on the condition of n-person includes the possibility of 2^n coalitions. However, in real world situations analogous to n-person games the persons involved do not seriously consider each one of the 2^n possible coalitions. In other words, restraints exist in the real world which, for all intents and purposes, limit the actual choice among the possible coalitions. Therefore,

the task of n-person game theory is to specify similar restraints in the model in the hope that they can then be discovered in reality. More hopefully still, the theory [or a model incorporating the conditions of zero-sum, n-person game theory] will define sufficient restraints so that one and only one coalition is left. Were that goal to be attained, then for every real situation analogous to an n-person game it would be possible to assert that a one best coalition exists.[25]

Although it is not possible to define the restraints in such a manner that only one best coalition remains, the above statement by Riker is an example of his supposition that a model can be constructed in such a manner that the relationships in the model correspond to some essential degree with the structure of actual coalition formulation. Because the structure of a model based on the conditions of n-person, zero-sum represents, to some extent at least, the real situation of coalition formulation, it is possible to deduce from this model a principle (the size principle) which, when translated into empirical terms, is capable of empirical testing.[26]

[22]Riker, The Theory of Political Coalitions, p. 29.

[23]Ibid., pp. 30-31.   [24]Ibid., pp. 34-46.

[25]Ibid., p. 36.   [26]Ibid., pp. 45-47.

This assumption of the similarity of structure between the model and reality is stated throughout Riker's study and not just limited to his analysis of the model as n-person, zero-sum. For example, in the chapter entitled "Strategy in Coalition-Building" two limitations are established in reference to the formulation of coalitions. Of primary importance to the case in point is the restriction which states that the model will be so constructed that no more than five proto-coalitions (a proto-coalition is any subset of a decision-making body which is partitioned into three or more disjoint subsets such that no subset or proto-coalition has the weight or votes to make a decision) will be involved in the decision-making process in the next to the last stage before the final decision is made. As Riker says, this limitation is imposed primarily for numerical convenience yet it "...does not involve too great a departure in the model from the conditions of reality."[27] A model, then, constructed with such a limitation does not depart from the essential character of coalition-building and, in fact, the model as a whole "represents" the actual social process.[28]

Having established the point that the construction of a useful logical model involves an isomorphism of structure between the model and reality, the significance of this characteristic of logical models remains to be discussed. In the previous chapter it was argued that the model as an example of a deductive system imposed certain limitations upon the model as a tool for investigating or explaining political phenomena. The assumption of isomorphism, on the other hand, does not impose any such limitation on the model, but rather, the similarity of structure between the model and reality is a prerequisite for the utility of the model.

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[27]Ibid., p. 128.

[28]Ibid., p. 148. One of the main points of Riker's study is that instability is a fundamental aspect of the model and this instability is likewise an attribute of the real political situation. In this sense, then, the structure of the model corresponds to the structure of reality. In his concluding remarks concerning the instability contained within the model, the statement is made that "insofar as the structure of the model reflects the structure of the real world, its politics too are fundamentally and inherently unstable." Ibid., p. 186. Emphasis added.

Therefore, the crucial question in evaluating the significance of the isomorphism of structure between the model and reality is not one of deciding if such an assumption should be made. This is not the primary question because isomorphism must be assumed if the model is to have any possible utility. The really important problem to be solved is the degree of isomorphism between model and reality that must be assumed or stated in order to have some assurance that the model will be useful for the study of politics. A partial solution to this problem can be stated if two mutually extreme degrees of isomorphism can be seen as inadequate in relating the model to reality. The rejection of these two extreme positions will mean that the solution to the problem lies somewhere between them.[29]

The first position that must be rejected is the view that reality or statements about reality have the same logically necessary relationships as the model itself. If "theory" is defined as a set of testable hypotheses, then the danger of such a view is

> ...that of transferring the logical necessity of some of the features of the chosen model on to the theory, and thus of supposing, wrongly, that the theory, or parts of the theory, have a logical necessity which is in fact fictitious.[30]

In other words, assuming the logical validity of the model, the relationships in the model between the terms and postulates are logically necessary, that is, true by definition; whereas the relationships within the empirical theory are contingent, that is, their truth is dependent upon empirical verification. Furthermore, it must be remembered that the model considers only the essential relationships of the variables of the problem or situation. The model, therefore, postulates a low degree of relational complexity even though model builders would admit that the real situation for which it is a model has a high degree of complexity.

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[29]To a certain extent the following discussion is a moot point in that it was previously stated in the analysis of isomorphism and homomorphism that a strict equality of structure between model and reality is never assumed by model builders. Nevertheless, an examination of these two extreme positions will help to indicate the nature of the problem and, hopefully, at least a partial answer.

[30]Braithwaite, Scientific Explanation, p. 94.

If the degree of isomorphism between the model and reality (or a theory about reality) is assumed to mean that the simplistic, logical structure of the model is the same as the (complex) structure of reality (or, perhaps more accurately, the structure of propositions about reality), then an inaccurate picture of reality will be acquired. In general, the subject matter of political science which is concerned with human behavior is held by most, if not all, theorists to be of such a nature that an explanation or analysis limited to logical deductions from simplistic assumptions is inadequate. Therefore, a view which assumed a degree of isomorphism between the model and reality which imposed the simplistic, logical relationships of the model upon reality must be rejected.

The other extreme position would be stated as that view which takes as its starting point the complex structure of reality and then assumes that the model must mirror this complexity. This degree of isomorphism is inadequate because, from a practical point of view, a model based on such a degree of isomorphism would not be manageable. Its complexity would therefore defeat the purpose of constructing the model which is to simplify a complex, involved process or situation.

From the above, it is possible to derive an incomplete, yet helpful answer to the question of the extent isomorphism of structure that must be assumed between the model and reality. On the one hand, it is evident that the simplistic, logical relationships of the model cannot be attributed equally to a theory about the real world or the real world itself. Conversely, to insist that the structure of the model reflect, in detail, the complex relationships of the real world is to defeat the purpose of model building as a tool for the aid in investigating political phenomena. A rejection of these two extreme positions does not, in itself, answer the original problem but it does suggest the form in which the answer must be stated.

Although the logical necessity of the model must not be imposed upon reality, yet at the same time the assumption must be made that the logical structure of the relationships in the model correspond to some extent with reality. If this assumption is not made then there is no reason for supposing that the model can hypothesize or in any way elucidate the real political situation for which it is a model. If, for example, a model incorporating the logical or mathematical relationships

of n-person games is not _in some essential sense_ similar to real-life politics then no ground exists for presuming that such a model will be of any use.

The same general conclusion can be derived from a consideration of the opposite extreme position. Although it is true that the purpose of model building in general would be defeated if one insisted that the model incorporate all of the complexities of the real world, yet it is likewise valid to require that the model mirror _to some essential extent_ the actual relationships that exist in the real world. The reason for saying this is obvious. If the model does not incorporate at least some of the relationships of the real world how could it aid in an understanding of that aspect of reality for which it is a model?

The degree of isomorphism of structure between the model and reality that is "essential" can be determined in only one way. It cannot be established _a priori_ but only on the basis of the model's utility. If the model is constructed to analyze coalition formulation or to discover a behavioral rule for rational voters in a democratic society, and if the model is successful in its stated aims, then there is no reason to say that the degree of existing isomorphism should be greater or less than it is. However, if the model is unsuccessful then it is reasonable to suspect that (a) the model is attempting to impose an unwarranted logical rigidity on the empirical phenomenon, or (b) the structure of the model is too simplistic and therefore excludes crucial factors of the real problem.

From what has been said so far, it does not seem as though the assumption of an isomorphism of structure between the model and reality forces any unnecessary ontological postulates upon model builders. The only presupposition that is necessitated by this assumption is that if the model is to be useful then it must be related to that aspect of the real world for which it is a model. One indispensable connection between the model and reality involves a similarity of structure — isomorphism.

Summary

In general, the purpose of this chapter has been two-fold. At the outset, a definition of isomorphism was established. The essence of this concept was seen to involve an assumption that a degree of similarity of structure existed between the model and reality. Having established by some concrete examples that logical model builders do in fact make such an assumption of isomorphism, the chapter concluded with a statement concerning the degree or extent of isomorphism that is necessary in the construction of a logical model.

Since the structural relationship between the model and reality is a matter of degree or extent and not a one-to-one correspondence, one can speak of the model as being an abstraction from reality. This characteristic of logical models as an abstraction will receive more exhaustive treatment in the following chapter.

CHAPTER V

THE ABSTRACT NATURE OF LOGICAL MODELS

A deductive system is...doubly abstract: it abstracts from the specific qualities of a subject matter, and it selects some relations and neglects others.[1]

In the discussion of the assumption of isomorphism of structure between the model and reality the point was made that the structure of the model is not identical with the structure of the real world. The structure of the model is more simplistic than that aspect of reality for which it is a model. This same notion of "simplicity" also carries over in reference to the terms of the model. In other words, the terms or concepts of the model are abstract—for the most part, they do not designate in any absolute sense real empirical referents. For example, the term "individual" in the model is so defined in most cases that there is no attempt to imply that such "individuals" (as defined) exist in the real world. In Downs' model all psychological and ethical motivations are excluded from the model concept of "individual" even though such factors are admitted as influential in the behavior of real persons. And, in general the other models of Buchanan and Tullock and Riker which are based on the characteristics of economic theory, including the definition of "individuals" as utility maximizing, make no claim that such individuals really exist. The only claim made is that individuals in the real world, at least to some extent, act to maximize utility (in terms of money, votes, wins) although some individuals, or perhaps all, act for other reasons as well.

To say, therefore, that logical models include abstract terms or concepts is not to say that the terms have no connection with reality. The conclusion to be drawn from the abstract nature of logical models is merely the notion that the model terms or symbols are more simplistic than their empirical referents.

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[1]Cohen and Nagel, _Readings in the Philosophy of Science_, eds. Feigl and Brodbeck, pp. 138-39.

Two questions arise in reference to this characteristic of logical models. On the one hand, a justification must be found for the use of abstract terms and secondly, a basis must be found for determining the degree of abstractness that is essential for the construction of a useful logical model. In this chapter these two problems will be dealt with as well as other factors of logical models that arise because of the inclusion of abstract terms or concepts in the model.

A realization that the correspondence between a concept (designated by a word or symbol) and a thing is never absolute is a beginning toward a justification of the use of abstract terms. To demand absolute exactness (assuming that such exactness is possible) would necessitate lengthy verbosities of no utility. A partial justification for the use of abstract terms, then, can be based on the drawbacks of demanding an absolute one-to-one correspondence between the term and reality.

A more positive basis for justification can be acquired by an examination of the use of theoretical terms in the physical sciences. A physicist, for example, often uses theoretical terms (electron, ψ-function) without attempting to answer such questions as, "What is the concept denoted by the symbol ψ ?" or "Do electrons really exist?" A physicist does not have to establish the ontological status of the theoretical concepts symbolized in the model in order to justify their use. An explanation of the way in which such terms are used in the model may, in itself, prove beneficial.[2] Assuming that there is some connection between the model and reality—a necessary assumption if the model is to be useful—a reluctance to discuss the reality of the concepts or terms may mean that empirical precision is sacrificed but the simplicity gained may result in getting at the fundamentals of the situation.[3]

Shifting to examples in the social sciences, it is evident that certain statements or propositions are, from an empirical point of view, inherently untestable. One such example that can be given is Freud's assumption about the existence of an unconscious mind. Although an exact empirical referent cannot be established for "an unconscious mind"

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[2]Braithwaite, Scientific Explanation, pp. 82-85.

[3]Anatol Rapoport, "Various Meanings of 'Theory'," American Political Science Review, LII, No. 4 (December, 1958), p. 975.

(in the same sense in which an empirical referent cannot be established for a ψ-function) a model incorporating such a concept may result in important, non-obvious testable hypotheses. In other words, models incorporating abstract terms or symbols may have heuristic value and therefore to dismiss the model because it is abstract may be to throw away the possibility of a useful construct because it fails to meet some preconceived ontological assumption. In the realm of science utility is a powerful criterion and if a model is to be dismissed in the science of politics it cannot be done on purely non-utilitarian bases.

The overriding force of the utility criterion is even admitted by one political scientist although he himself is of the opinion that the abstract system of other political theorists is "premature." In his brief statement about Arrow's, Social Choice and Individual Values,[4] Douglas N. Morgan sets out four unreal or abstract assumptions made by Arrow. Referring to these empirically "false" assumptions Morgan says that "this is sensible science, reminiscent of the often outlandish assumptions upon which some physical deductions are made to rest."[5] The inclusion of these unreal assumptions is "sensible" because it results in meaningful deductions. Morgan's view is cited here not because he is the best authority on the use of abstract terms in scientific systems—for certainly he is not—but because his position is an example of the fact that the ultimate evaluation of a model in terms of its unrealisitc assumption is a matter of utility. If the end result of the construction of a model is useful, then the assumptions are sensible and justified and from the scientist's point of view that is the end of the matter.

From what has been said in previous chapters of this study, it is evident that the construction of a general model (Downs, Buchanan and Tullock, and Riker) involves the incorporation of abstract terms and it is also evident that their inclusion in the models is justified on the basis of the utility of such models. However, if one moves from the

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[4](New York: John Wiley and Sons, Inc., 1951).

[5]Douglas N. Morgan, "A Postscript to Professor Dahl's 'Preface'," American Political Review, LI, No. 4 (December, 1957), n. 7, p. 1047.

subject matter of the individual sciences (natural or social) to the realm of the philosophy of science an even more convincing argument can be found for the justification of the use of abstract terms and concepts. Undoubtedly, one of the greatest scholars in this field was Alfred North Whitehead. He argued that not only is abstraction useful but it is **necessary** for all thought. Although he is emphatic that a danger exists in abstraction (the danger of confusing the abstraction with reality) his statement for the utility and necessity of abstraction is worthy of note.

> The advantage of confining attention to a definite group of abstractions, is that you confine your thoughts to clear-cut definite things, with clear-cut definite relations. Accordingly, if you have a logical head, you can deduce a variety of conclusions respecting the relationships between these abstract entities. Furthermore, if the abstractions are well-founded, that is to say, if they do not abstract from everything that is important in experience, the scientific thought which confines itself to these abstractions will arrive at a variety of important truths relating to our experience of nature.
> ...You cannot think without abstractions....[6]

Once the concept has been defined and its use justified the further problem remains to determine the degree or amount of abstraction that must be assumed in model construction. To a certain extent the discussion of this latter point will parallel the analysis in the previous chapter concerning isomorphism. In other words, it is possible to indicate two extreme degrees of the connection between the model terms and reality, both of which will have to be rejected. The rejection of the extreme positions means that the necessary degree of abstraction in model building will be somewhere between these two extremities.

The first position that must be rejected is the view that the terms or symbols in the model must have a one-to-one correspondence with empirical referents. In a strict sense, such a view is a denial of the abstractness of the model. At the least this requirement would complicate the model to a great extent and at most might even be considered an impossibility—especially in light of Whitehead's position. The rejection of this extreme point of view, however, does not imply the acceptance of the opposite extreme, namely, that there is no need

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[6]Alfred North Whitehead, _Science and the Modern World_ (New York: The New American Library, 1954), p. 59.

to establish any connection between the terms or concepts of the model and reality. An acceptance of this latter view would seem to provide no assurance at all that the model would be useful in the understanding of the real world. An adequate solution to the problem, therefore, must contain a rejection of both extreme positions with the establishment of the necessary degree of abstraction lying between the two extremes.

Although it is difficult to establish the exact degree of realism that must be included within the terms or concepts of the model, there is no doubt that at least some "realism" is needed. Downs, for example, in his discussion of Buchanan's essay, "The Pure Theory of Government Finance,"[7] states that the "organismic" approach to decision-making by the state discussed by Buchanan has no substantive content and it is, therefore, "...useless as a guide to practical decisions."[8] Clearly, the implication is that a model must have some substantive or real content if it is to be a useful model. Downs' model is evidence for such an inference since he claims that his model postulates behavior and includes assumptions (for example, the assumption of uncertainty) which are consistent with the real world.[9] Buchanan and Tullock likewise assert a connection between the concepts of the model and reality. One of the basic assumptions of their model is that the individuals act to maximize interest and although the authors do not "glorify" this aspect of behavior they do suggest that empirical evidence is available to indicate that men do, in fact, act in such a manner.[10] Riker, like Downs and Buchanan and Tullock, also suggests that there is a definite relationship between the concepts employed in the model and the real world. A case in point is his discussion of rationality which was defined in the model as behavior directed toward winning. As Riker points out, the only way of verifying this assumption is by arriving at non-obvious

[7]James Buchanan, "The Pure Theory of Government Finance: A Suggested Approach," Journal of Political Economy, LVII, (December, 1949), pp. 496-505, cited in Downs, An Economic Theory of Democracy, p. 15.

[8]Downs, An Economic Theory of Democracy, p. 15.

[9]Ibid., p. 20.

[10]Buchanan and Tullock, The Calculus of Consent, p. 305.

verifiable hypotheses from a model incorporating such an assumption. Yet, at the same time he attempts to show that the condition is applicable to the real world by pointing out that the fiduciary relationship,[11] an acceptable cannon of behavior, is prevalent in Western society. Like the model definition of rationality which places primary emphasis upon winning, behavior in the real world governed by the fiduciary relationship is likewise governed by the obligation to maximize (money) and to win. Therefore, insofar as

> ...the fiduciary morality imposes an obligation to behave rationally and [insofar as] ...most economic and political decisions are made by agents governed by the fiduciary obligation ...then it must be the case that rational behavior is at least striven for in most areas of business and public life. Since most of the evidence by which the rationality condition is discredited comes from situations where individuals act wholly for themselves... it may be quite irrelevant to the kinds of decisions with which politics and economics are mostly concerned. At any rate, as long as the fiduciary morality exists [in the real world], there seems to be some justification for using models containing the rationality condition [of the model, i.e. rational behavior defined in terms of winning]....[12]

So far in the examination of the correspondence between the terms of the model and empirical referents two general points have been established. First, the model **must** be abstract to some degree if it is to be manageable. On the other hand, however, the possibility of the model being useful necessitates that it include some degree of realism-- or expressed differently, the terms or concepts of the model must have some connection with reality. The problem at this point is to state more explicitly the degree or amount of realism demanded by the construction of a logical model.

It is obvious that the desirable degree of abstractness or indefiniteness is the minimum amount that is compatible with a manageable model. In other words, the use of the model as a tool for empirical research is enhanced the more definite the connection between the terms

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[11]A fiduciary relation "...exists where there is special confidence reposed in one who in equity and good conscience is bound to act in good faith and with due regard to interests of one reposing the confidence." Henry Campbell Black, Black's Law Dictionary (4th ed.; St. Paul: West Publishing Co., 1951), pp. 754-55.

[12]Riker, The Theory of Political Coalitions, pp. 27-28.

of the model and reality. This line of reasoning is developed by Pareto in his discussion of the scientific method defined as a procedure utilizing logical constructs for empirical investigation. Although it is true that one goes outside the strictly defined scientific method by the use of abstract terms, yet,

> ...if our terms [according to Pareto] have that minimum of indefiniteness which corresponds to the present state of knowledge, they take us so little outside the experimental field that we may overlook the extrusion.[13]

A minimum of "indefiniteness" or abstraction within the terms or concepts, however, must be based upon the assumption that this minimum degree, while abstract, yet contains the essential characteristics or aspects of the real situation or empirical referent. But to say that the terms, or the model as a whole, contains the essential aspects of reality is to make yet a further assumption, namely, that the model builder has some knowledge of the situation which he is investigating. In the construction of a model to say that some variables are not as important as others is either to make a hypothesis or draw a conclusion about the phenomena for which the model is constructed. These two assumptions, although distinguishable, are yet inter-related because to say that the model includes the essential aspects is to assume some prior analysis. For this reason the two assumptions will be discussed jointly, beginning with a statement of what is meant by the inclusion of the "essential" aspects of reality into the model. Following this statement will be an evaluation of the assumptions pointing out their implications for model building as a method of investigating political phenomena.

Just as the economist knows that there is no such thing in the real world as an economic man who singlemindedly maximizes profit, model builders in political science realize the unreality or abstract nature of their model concepts. Yet, both the economist and the political scientist are certain that it is useful to construct models utilizing such concepts because they are convinced that most people in the real world do want money, do act to maximize self interest, and do desire

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[13]Vilfredo Pareto, The Mind and Society, Vol I, trans. Andrew Bongiorno and Arthur Livingston (New York: Harcourt, Brace and Co., 1935), p. 58.

to win instead of lose. In other words, the construction of a useful
model demands that the essential aspects of the real situation are in-
cluded within the logical system. The essential aspects are those
factors and factor values that the model builder has some reason to be-
lieve operate in the particular instance or situation that he wishes to
understand and explain.

A clear-cut example of the utility of a model based upon the as-
sumption of the models' inclusion of the essential factors can be found
in Talcott Parson's essay, "'Voting' and the Equilibrium of the Ameri-
can Political System."[14] In this study Parsons wants to determine how
the voting process functions and his method involves the construction
of an abstract analytical scheme of inputs and outputs. This scheme of
the relations of interchange of inputs and outputs is applied to the
American political structure. He used the model of input-output as a
framework into which he places the relevant variables concerned with
the process (that is, the voting process) by which control of the feder-
al government is decided.

At the "support level" (which, in terms of the model, would be
designated an input affecting leadership selection) voting is the most
important variable, although, as Parsons says, there are "of course"
other influences operating at this level. Some of these other influ-
ential factors are public opinion, threats, etc. The reason why the
voting process is considered the most important is that it is the "cen-
tral focus of the process of selection"[15] of leaders. In other words,
the model is abstract in the sense that some variables of the situation
are excluded, but nevertheless it includes the essential aspects of the
real world—in this case, the voting process.

Like Downs, Parsons uses a one-dimensional continuum between po-
litical parties, although no attempt is made to conclude that American
political parties, for example, can be distinguished in every case by
means of such a simplistic assumption. Nevertheless, the assumption
is true to some extent and points out valid distinction between the
parties.

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[14]_American Voting Behavior_, eds. Burdick and Brodbeck, pp. 80-120.

[15]_Ibid._, p. 86.

A broad ideological line can...be discerned. I would like to characterize this distinction as that between "right" and "left" in a sense appropriate to American conditions. The focus of the American right in this sense is the organization of the free-enterprise economy....The "left" ...has been the focus of those elements predisposed to favor positive action on the political level.... On a broad basis this distinction adequately characterizes the main line of distinction between the Republican and Democrats.[16]

In order to determine the significance of the abstract nature of logical models the concept of "rationality" or "rational behavior" will be analyzed in detail. There are two reasons for selecting this concept for discussion. First, the terms have been introduced earlier in this study and therefore at least a partial basis exists as a prelude to the more detailed analysis. Second, and of more importance, the concept of rationality is included in most models in political science and is recognized as a crucial aspect in model construction.

As is evident, the concept of rational behavior is not defined in exactly the same manner by all model builders. Downs and Buchanan and Tullock, for example, define rational behavior as action directed towards the maximization of utility whereas Riker expresses the concept in terms of behavior leading toward winning. Although these verbal differences exist, the concept "rational behavior" as used in the construction of logical models in political science contains certain attributes that are generally accepted by all. It is usually thought, for example, that rational action is possible only when the individual can state his ends (votes, money, gains, etc.) and the means to acquire those ends. Second, rational behavior depends upon the availability of information that leads to a determination of the best means to attain the stated ends. To act rationally, therefore, means to act on the basis of information relevant to the means and ends and not on the basis of emotion, prejudice or whim. Third, the rational man is the one who has the ability to order preferences or ends transitively. Transitivity can be defined in the following manner. If there exists three goals or ends, a, b, c, such that a relation R exists between pairs of them, then R is transitive when the following inference is true: if aRb and bRc, then aRc.[17]

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[16]Ibid., pp. 88-89.

[17]William H. Riker, "The Paradox of Voting and Congressional Rules

A non-rational individual, on the other hand, would be one responding to various situations in terms of non-logical pressures or influences. One can think of a non-logical influence as one which, in many cases, the individual is not aware of as affecting his behavior and one which he would not consider as a valid influence if he were aware of it. Although it is obvious that non-logical pressures influence behavior in the real world, logical models in political science are usually based upon the assumption that the individuals act in a purely rational manner.

The justification for a model based on the rationality assumption is the belief that the explanatory power that would accompany the inclusion of non-logical influential variables would not be worth the added complexity introduced by these variables. However, the choice of assumptions has far ranging consequences for the usefulness of the model. For even if one is interested in the behavior of nation-states, political parties or groups of any sort, the assumptions made about individual behavior will affect one's understanding of group behavior.

The significance of this assumption of rationality (and, in general, of all abstract assumptions in model building) can be evaluated from two sides. The first question that must be asked is whether or not the assumption of rational behavior as postulated in the model is, in fact, closely related to behavior in the real world so that reliable conclusions can be expected to result. The second line of analysis is concerned with the relationship between the model as a deductive system and its abstract nature. These two questions will be examined in their respective order.

An analysis of the abstract nature of logical models must be concerned with an evaluation of the concepts of the model to determine whether or not they are about the _essential_ aspects of the real world. Some interesting problems arise when the concept of rational behavior is put to this test. Sidney Verba, for example, lists six reasons why the assumption of pure rationality does not conform to the real world.[13]

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for Voting on Amendments," _American Political Science Review_, LII, No. 2 (June, 1958), p. 350.

[18]Sidney Verba, "Assumptions of Rationality and Non-Rationality in Models of the International System," _The International System_, eds. Knorr and Verba, pp. 109-13. A statement by Riker on this point is also

Firstly, the model can handle only "the simplest choices." Secondly, the individual must be aware of his own values and be able to order them. As Verba points out, "such self-awareness is rare." It is Verba's contention that these differences between the model and the real world severely limit the utility of models based upon the rationality assumption. His conclusion is that rationality models would be extremely useful "if only" the individuals in the real world acted rationally. In other words, rationality models would be more useful if individuals acted rationally.[19]

A partial answer to this dilemma arising from the difference between the model concept of pure rationality and real world behavior would consist in the construction of models in which rational behavior was not defined in such a stringent manner. "Pure" rationality is perhaps too crisp and precise to be applied to social phenomena. In the real world human behavior is extremely malleable, subject to fewer restraints than most of the objects of the physical sciences and, therefore, relatively unpredictable—especially in reference to <u>individual</u> behavior. For these reasons, it would seem more methodologically sound to construct models which assume that there is an <u>area or range</u> within which action could be defined as rational. Rational action in such models could be formally stated in a <u>set</u> of solutions, any one of which would be stable or predictable given the conditions or parameters of the model.[20]

Although Verba's argument is concerned mainly with pointing out the differences between the assumed behavior in the model and behavior in the real world, other theorists carry the analysis a bit further and

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worthy of note. "In a large assembly with many parties, the bargaining situation is so confused that members cannot determine where they stand. Indeed, in such assemblies, by reason of the complexities of relationships, members probably cannot be expected to behave rationally." William H. Riker, "A Test of the Adequacy of the Power Index," <u>Behavioral Science</u>, IV, No. 2 (April, 1959), p. 131.

[19]Verba, <u>The International System</u>, eds. Knorr and Verba, p. 113.

[20]For the development of this type of argument and attempts to construct "limited rationality" models see, Joseph J. Spengler, "On the Progress of Quantification in Economics," <u>Isis</u>, LII, Part II, No. 168 (June, 1961), pp. 258-76; Herbert Simon, <u>Models of Man</u> (New York: John Wiley and Sons, Inc., 1957).

state explicitly that irrational behavior is an essential aspect of real behavior. The argument is made, not only that irrational behavior is an aspect of real behavior, but furthermore, that irrational behavior is an integral part of American political system--or, in terms of the above discussion, irrational behavior is an essential aspect of real world politics. According to Eugene Burdick, the American voter is not rational even if rationality is defined in the most simple terms of possessing information, acting on that information and the self-conscious act of making a decision.[21] Although the American voter cannot be said to be rational (in terms of the model definition) yet his behavior is an integral aspect of the real political system. In fact, Talcott Parsons argues that non-rational behavior is essential to the maintenance of democratic two-party systems. According to Parsons:

> There must be mechanisms by which the average voter can come to a "responsible" decision that is meaningful to him. He must not, in too many cases, withdraw to non-voting, nor be too susceptible to appeals that would be grossly disruptive of the stability of the system. Since the intellectual problems involved in a rational solution are not practicably soluble, ...the mechanisms are typically non-rational. They involve stabilization of political attitudes <u>in terms of association with other members of the principal solidary groups in which the voter is involved.</u> In terms of party affiliation this may be called "traditionalism." The traditionalistic operation of non-rational mechanisms is a condition of the stability of the system.[22]

Pointing out that irrational behavior is an essential aspect of the real world is not to say that models based on the assumption of rationality have no possibility of being useful in the study of politics. One can conclude, however, that such models are limited in their ability as tools for investigating political situations. They are limited to the extent that an understanding of irrational behavior is crucial to an understanding of the real world. The construction of a logical model based upon the postulate of rational behavior assumes, therefore, that irrational behavior is not essential to an understanding of that aspect of reality for which the model is constructed. This assumption, depending upon the phenomenon under investigation, may or may not be warranted.

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[21]Eugene Burdick, "Political Theory and the Voting Studies," <u>American Voting Behavior</u>, eds. Burdick and Brodbeck, p. 139.

[22]Parsons, <u>American Voting Behavior</u>, eds. Burdick and Brodbeck, pp. 91-92. Also, see Stokes and Ibersen, <u>The Public Opinion Quarterly</u>, XXVI, No. 2, pp. 159-71.

Ultimately, the final word on this point can be stated only when the utility of the model, in terms of its testable conclusions, is evaluated. (This aspect of the problem will be discussed in the following chapter.)

In general, the problems arising from the use of the term "rationality" in many models constructed in political science stem from the emphasis upon the individual as the central aspect of politics and political decision-making. Without going into the pro and con arguments of the individualistic approach as opposed to the group approach, it does seem reasonable to say that the latter approach to the study of politics has proven to be of some value. Furthermore, an emphasis upon group behavior over a long period of time may, in many instances, be more clearly designated as rational behavior in some meaningful sense than would be the case if the emphasis of the model is upon the behavior of the individual. A study of group behavior in terms of a rationality criterion will, of course, raise many new problems, such as, what constitutes a group or aggregate and what is group behavior. Ultimately, it may be that a model based on group behavior would create as many (if not more) problems than it could possibly solve. But in any case, two facts are clear: (1) It is extremely difficult to apply a definition of rationality to individual voters, citizens, or decision-makers in the real world. (2) An emphasis upon group behavior over an extended period of time is one probable way of meeting this difficulty.

The ramifications of using abstract concepts in logical models is also evident when this characteristic of models is seen in connection with models as deductive systems. In general, the significance of the use of abstract concepts is exemplified when the model, an abstract deductive system, is related to reality which is neither abstract nor completely explicable by means of logically connected deductive propositions.[23] An examination of Downs' use of rationality will indicate, in more detail, the nature of this problem of relating the logical model to reality.

At the outset of his book, Downs explicitly states the arbitrary

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[23]Although it is a goal of the sciences (physical and social) to establish explanatory deductive systems, this goal has not yet been acquired. Therefore, it seems reasonable to conclude that all of reality, and in many cases, all aspects of particular situations, cannot be stated in deductive systems.

nature of the model and acknowledges the unreality of its basic rationality assumption. Then on page 20, he says that his model is a realistic guide and as such his task is to "...discover what form of political behavior is rational for the government and citizens in a democracy."[24] Downs claims that the model not only hypothesizes about the real world, but he also says that the model "...constructs a positive norm by which to distinguish between rational and irrational behavior in politics."[25] Certainly, in the model, given its assumptions and limitations, one has a norm by which to discover rational and irrational behavior in the model; but since rationality and irrationality in the model are defined in reference to unreal assumptions, how can a legitimate comparison be made with the real world that is so different? One cannot say that a certain action in the real world is irrational just because it does not coincide with the model definition of rationality.[26]

The employment of abstract terms in logical models, therefore, raised two problems--problems which are analytically distinct yet, in practice, related. To use an abstract term, such as "rational behavior," for example, implies that one already knows something about human behavior and that the aspect designated as "rational" is, in fact, essential to the situation or problem being investigated. Furthermore, insofar as irrational or non-rational behavior is known to be influential in the real world, yet excluded from the model, a further assumption is made, namely, that the inclusion of irrational behavior in the model is not essential to an understanding of the real situation. Whether or not the exclusion of any variable is justified will depend ultimately on the ability of the model to be helpful in understanding the phenomenon under investigation. It would seem, for example, at least from Parson's point of view, that the latter assumption of excluding irrational behavior would be unwarranted for an adequate understanding of the American

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[24]Downs, _An Economic Theory of Democracy_, p. 20.

[25]_Ibid._, p. 35.

[26]In his discussion of the multi-party model and rationality, Downs admits that "...what is rational for some voters in reality may be irrational in our model," (p. 145) because rationality is defined in the model as voting to elect a government. In an actual situation, however, a man may be rational and vote for some other reason. But if one admits that this split exists between the meaning of rationality in the model

party system.

The second problem arising from the use of abstract terms in logical models concerns the relationship between the model and reality. As was pointed out in Chapter II, a model in reference to its logical, deductive nature will be true of the real world only if (1) the deductions are valid and (2) the postulates are true. In reference to the model as a tool for empirical research this same point can be stated in the following manner. A model will be a useful and satisfactory explanation of the real world if (1) the deductions from it are valid and (2) the postulates include the essential properties and relationships. To the extent that the abstract terms do not include at least the essential aspects of the real world then the possible utility of models utilizing such terms is reduced; especially in reference to the testable hypotheses deduced from them.

The utility of logical models, however, is not limited to their ability to lead to testable hypotheses. Although the primary aim of such models is to result in empirically verifiable postulates, the fact that logical models deal with such concepts as "pure rationality," "utility maximizing individuals," "pure conflict," and other abstract terms means that the model may function in a normative sense. The exclusion of some variables (which results in what has been defined as abstract terms) states the conditions under which the relationships postulated in the model will be true. In other words, the construction of a logical model may result in "insights" into idealized or abstract situations.

The ability of logical models to function in a normative sense is exemplified clearly in game theory models. For the most part, such models are based on the assumptions of "pure" rational behavior and "pure" conflict situations. Although many scholars have pointed out the limitations of such models for explaining behavior or conflict in the real world,[27] the ability of abstract logical models to establish ideal types that can lead to insights concerning (for example) conflict

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and its real-life meaning, how does the model have anything to say about actual rational behavior?

[27]Anatol Rapoport, Fights, Games, and Debates (Ann Arbor: The University of Michigan Press, 1960), pp. 232-34. Schelling, The Strategy of Conflict, p. 163. Kaplan, System and Process, p. 172.

and rational behavior seems generally accepted.

The construction of a model using the axiomatic base of gaming theory can lead one to think about conflict in a manner that would not be possible without the tools and techniques unique to this approach. Analyzing conflict in terms of game theory, then, may lead to an understanding of some aspects of conflict in somewhat the same manner that the construction of a normative model of democracy may lead to a clear understanding of the characteristics of an ideal democracy.

Although this study has pointed out some weak points in the models constructed by Buchanan and Tullock, their use of game theory as a tool for analyzing majority voting results in some interesting insights into this decision-making procedure. It is often thought (especially, but not exclusively, by the layman) that the operation of majority rule will necessarily result in the best possible outcome for all concerned. However, as Buchanan and Tullock point out, this is not necessarily the case. The authors state that an examination of the concept of majority rule in terms of game theory leads to the conclusion that side payments (logrolling) is an integral aspect of decision-making and a necessary factor to be considered in any evaluation of the benefits of the majority rule.

> The generalized conclusion that may be reached as a result of the application of elementary game theory to the institution of simple majority voting is evident. There is nothing inherent in the operation of this voting rule that will produce "desirable" collective decisions, considered in terms of individuals' own evaluations of possible social alternatives. Instead, majority voting [may] ... result in an overinvestment in the public sector when the investment projects provide differential benefits or are financed from differential taxation. There is nothing in the operation of majority rule to insure that public investment is more "productive" than alternative employments of resources....Insofar as the vote-trading processes which emerge out of the sequence of separate issues confronted produce something akin to side payments, this resource-wasteful aspect of majority voting will tend to be reduced in significance.[28]

The insights to be gained from the models of Buchanan and Tullock, however, are not limited to those instances where the axioms of game theory are applied to majority rule. The application of the logical models to the operation of the bicameral legislature leads to such

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[28]Buchanan and Tullock, The Calculus of Consent, p. 169.

conclusions as: (1) a two-house system will involve higher decision-making costs than a single-house system,[29] (2) there is no reason, on the basis of (1) to justify a two-house system unless one can expect a reduction in external costs,[30] and (3) there is no reason for a two-house system unless the basis for representation in each is different.[31]

It must be emphasized that the empirical status of these conclusions is not under consideration at this time. These conclusions are, in fact, the result of applying the two cost functions of constitutional government to an abstract bicameral legislature. Starting with the initial assumptions of the model which are then manipulated by the rules of deductive logic, the conclusions are insights into the rationale of a bicameral legislature. These conclusions may or may not be empirically true--but at the very least, one can say that they are insights into the rationale of a bicameral legislature given the model assumptions of rational behavior which is defined in terms of decision-making and expected external cost functions.

In general, the ability of logical models to lead to what has been called "insights" is, in fact, one of the major contributions of this method. The construction of a logical model (leaving aside for the present the verifiability of its deductions) often results in a clarification of such concepts as strategy, coalition formulation, conflict, etc. In this respect, the model can be seen as an intellectual experiment whose purpose is to determine the logical implications of certain basic assumptions.

The evaluation of any particular model, therefore, must take into account both the utility of the model in terms of its testable conclusions[32] and the ability of the model to clarify certain concepts such as strategy, conflict, etc. In the latter instance any criticism to the effect that the model does not predict reality is invalid. To criticize a logical model because of its unreality or its use of abstract-simplistic terms is valid only to the extent that it can be shown that the inclusion

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[29]Ibid., p. 235.   [30]Ibid., p. 236.   [31]Ibid.

[32]This aspect of logical models will be discussed in the following chapter.

of such terms results in non-verifiable or useless conclusions.[33]

Another normative aspect of logical models that stems from their inclusion of abstract terms is evident when the model is used as a construct which is _compared_ with the real world. That is, just as logical models may be used to gain insights into various concepts, they may also be used to establish an abstract picture of a two-party system, for example, which is then compared with actual two-party systems to determine the differences and/or similarities. Used in this comparative manner the construction of the model may lead to suggestions that explain the differences and/or similarities in reference to the assumptions and relationships postulated in the model.

Although Downs' model, for example, results in a long list of testable hypotheses, he also claims that the model may be compared to reality and thus suggests possible explanatory postulates about the operation of democratic government.

> Thus our model could be described as a study of political rationality from an economic point of view. By comparing the picture of rational behavior which emerges from this study with what is known about actual political behavior, the reader should be able to draw some interesting conclusions about the operation of democratic politics.[34]

This use of models in a comparative manner has been more closely identified with normative models, and, is only a secondary aspect of logical models (since the more important claim made by those constructing logical models is that they result in testable conclusions). Nevertheless, all of the logical models cited in this study can be seen as abstract constructs which, when compared with the real world, may suggest testable hypotheses and "interesting conclusions." In fact, when considered in light of the problems existing in the attempt to deduce testable hypotheses from an abstract deductive system, (a point that will be discussed in greater detail in the following chapter), the functioning of a model in a comparative sense may be more methodologically sound than would be the case if the model is constructed to result in testable deductions.

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[33]This point will be discussed in greater detail in the following chapter.

[34]Downs, _An Economic Theory of Democracy_, p. 14.

Summary

This Chapter has been an attempt to state the abstract nature of logical models and to indicate some of the more decisive implications that result from the use of abstract terms in logical deductive systems.

At the outset an abstract term or concept was defined as one that was more simplistic in that it did not include <u>all</u> of the aspects or variables of its empirical referent.

The use of such abstract terms was justified on two grounds. First, it was shown that a demand for a one-to-one correspondence between the term and reality was both undesirable and perhaps even impossible to acquire. Second, the point was made that the overriding criterion of utility may be satisfied in the construction of particular models even if the models entailed abstract terms and/or concepts.

Once the use of abstract terms in logical models was justified, the <u>degree</u> of abstractness compatible with a potentially useful model had to be determined. Although no specific formula was given that would ascertain this relationship between the model terms and their empirical referents, it was concluded that <u>at a minimum</u> the terms or concepts must entail the essential aspects of the phenomenon under investigation. Further examination of this aspect of logical models indicated some of the problems resulting from the use of abstract terms in a deductive system. It was shown, for example, that the problem of relating Downs' model to reality was further complicated when the model was considered as a construct employing abstract terms (rationality) embedded in a deductive system.

The Chapter ended with a brief statement of the normative functioning of logical models that result from their inclusion of abstract terms. Subjecting abstract terms and concepts to logical analysis may lead to insights and, furthermore, may provide a fruitful basis with which one can compare the real world. Such a comparison, it was argued, may suggest reasons for the difference and/or similarities between the model and reality.

CHAPTER VI

LOGICAL MODELS AND TESTABLE HYPOTHESES

...deductive inference is not an empirical matter. Strictly speaking, it does not inform us about the real world. We can assent to the truth of the conclusions only if two conditions have been met: (1) if we have decided that the premises are true and (2) if the conclusion is implicit in the premises.[1]

The examination of the relationship between logical models and testable hypotheses involves weaving together many of the lines of argument that have been presented in previous chapters. The characteristics of a logical model--namely, the fact that it is a logical deductive system which includes abstract or simplistic terms and relationships--greatly affects the hypotheses that can be deduced from it. Although many factors are involved in evaluating the potential utility of hypotheses deduced from logical models, the discussion to follow will attempt to sort out the crucial factors under five main points.

In order to provide a legitimate beginning for an analysis of logical models and testable hypotheses it will be necessary to indicate the relation between a model and a theory. With the establishment of this relationship as a basis, the discussion will proceed to an examination of two main factors relating to the potential utility of hypotheses deduced from logical models. Third, it will be shown that the utility of the conclusions is enhanced if empirical referents can be found for at least some of the terms in the model as well as for the terms in the conclusions. Fourth, the procedure used by Riker will be proposed as a methodologically sound way of dealing with the relationship between logical models and testable hypotheses. Lastly, the conclusions of the three general models (Downs, Buchanan and Tullock, Riker) will be evaluated in light of the significant, non-obvious criterion.

A model has been defined, in part, as a logical deductive system for which the terms "valid" or "invalid" are applicable, but not the

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[1] Thomas Landon Thorson, The Logic of Democracy (New York: Holt, Rinehart and Winston, 1962), p. 39.

terms "true" or "false." A <u>testable</u> deduction or hypothesis, however, means that one is concerned with empirical truth or falsity and, therefore, a way must be found to make the terms true and false meaningful in relation to the construction and use of logical models. These terms can be made relevant to logical models by (1) making a clear distinction between a model and a theory and by (2) indicating how a model may become a theory.

In a strict sense, a model is not a statement about reality but rather a set of equations or sentences incorporating certain symbols or terms manipulated by the rules of mathematical analysis or logic. A "logical model," then, refers to the form or structure in which the equations or propositions are clothed, it does not refer to content.[2] Because the model is a logical construct it makes no sense to say that a model is true or false; one can only say that it is a valid model (i.e., the conclusions <u>logically</u> follow from the premises), or an invalid one (i.e., the conclusions do not logically follow from the premises).

A "theory," on the other hand, is something quite different from a model. The distinction noted here between model and theory is that the latter refers to the operationalizing of the model. A model, therefore, is <u>not</u> a theory but it may become one if a segment of the real world is mapped into it.[3] In other words, if the symbols or terms in the model are translated into the data of the real world, then the model becomes a theory about the real world. If this translation takes place then one can designate the conclusions of the original model as true or false. The terms "true" and "false," therefore, are relevant to the deduced hypotheses of logical models when at least some of the terms of the model are given empirical referents.

With the establishment of this distinction between model and theory, it is possible to proceed to an examination of the hypotheses

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[2]For a further statement of models as forms or structures see, Herbert A. Simon and Allen Newell, "Models: Their Uses and Limitations," <u>The State of the Social Sciences</u>, ed. Leonard D. White (Chicago: The University of Chicago Press, 1956), pp. 66-83.

[3]C. H. Coombs, H. Raiffa, and R. M. Thrall, "Some Views of Mathematical Models and Measurement Theory," <u>Decision Processes</u>, eds. R. M. Thrall, C. H. Coombs, and R. L. Davis (New York: John Wiley and Sons, Inc., 1954), p. 25.

deduced from logical models. There are two main factors affecting the potential utility of the hypotheses. Of crucial significance is the fact that the model entails simplistic terms and relationships. This simplistic nature of logical models and its effect on the deductions will be discussed in reference to mathematical models, game models, and the n-person, zero-sum model constructed by Riker. The second factor involved in this problem is the necessity of finding empirical referents for at least some of the terms in the model. These two aspects of the problem will be discussed in their respective order.

Considering the model as a deductive system whose initial assumptions are abstract or simplified limits the potential utility of its logical deductions. This is evident especially in reference to mathematical models. As Rapoport says, the deductions of a mathematical model "...cannot be expected to be more accurate [in an empirical sense] than the assumed relations between the variables...."[4] Since the model is nothing more than a deductive system, its conclusions do not necessarily "explain" the real world, but must be considered as logical implications of the initial assumptions. The limitations of mathematical models arising from their simplistic nature is also stated by Max Black.

> The drastic simplifications demanded for success of the mathematical analysis entail a serious risk of confusing accuracy of the mathematics [i.e., its precision and lack of ambiguity] with strength of empirical verification in the original field. Especially important is it to remember that the mathematical treatment furnishes no **explanations**. Mathematics can be expected to do no more than to draw consequences from the original empirical [or abstract] assumptions.[5]

The limitation of the applicability of the conclusions of logical models is also evident in the construction of game models. In general, the reason given for explaining this limitation is the same one stated above in reference to mathematical models, namely, that the conclusions are nothing more than the logical implications of the abstract assumptions of the model. The nature of the deductions means, therefore,·

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[4]Anatol Rapoport, "Lewis F. Richardson's Mathematical Theory of War," The Journal of Conflict Resolution, I, No. 3 (September, 1957), p. 258.

[5]Max Black, Models and Metaphors (New York: Cornell University Press, 1962), p. 225.

that the conclusions of game models dealing with the logic of strategy, coalition formulation, etc., have no _a priori_ value in explaining how or why individual people actually behave in such situations.[6] As Schelling points out, the theoretical game model is not a statement explaining how individuals behave, but rather, "..._a specification of the framework_ within which they pursue certain objectives according to certain criteria."[7]

Even if attention is shifted from theoretical game _models_ to actual _games_ based on the axioms of game theory the relationship between the conclusions of the games and reality still poses problems. Whether the game is used to derive certain statistical evidence or to reveal unique modes of behavior, the game itself still remains nothing more than a concrete implementation of some game-theoretical model. This being the case, the game cannot lead to the conclusion that in a particular real-world situation a particular event is likely to occur or that in order to achieve a particular result in the real world, one type of action is likely to be more successful than another. This restriction of the degree of applicability of the results of games stems from the fact that the motivations of the opponents in the game are unknown. Furthermore, even if the motivations were known and the participants in the game could be instructed to act in accordance with them, the players would not be facing the concrete payoffs which would be operative in the situations of the real world.[8]

The discussion up to this point can be summarized by saying that the conclusions of logical models are the logical implications of initial postulates and not necessarily explanatory statements about the real world. In general, the point to be made is that the lack of

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[6]Rapoport, _Fights, Games, and Debates_, p. 212. This is not to say, however, that the conclusions of game models have no utility. As Rapoport points out, "...these conclusions are useful points of departure for making hypotheses about how people behave. The hypotheses serve to focus the investigators attention on what may be important determinants of behavior." _Ibid._

[7]T. C. Schelling, "Experimental Games and Bargaining Theory," _The International System_, eds. Knorr and Verba, p. 48. Emphasis added.

[8]The points stated in this paragraph were acquired from Quandt, _The International System_, eds. Knorr and Verba, p. 75.

empirical content that may be omitted from the model (i.e., its simplistic nature) limits the applicability of the logical deductions.

The limitation of the applicability of the deductions or implications of logical models is also made evident by an examination of Riker's model and its application to the state of world politics. In stating his explanation of Soviet behavior, he contrasts it with the "journalistic" interpretation.

> In the journalism of the West the dominant interpretation of the events in the world society during the last fifteen years is that of an aggressive imperial power (i.e., the Soviet Union) constantly upsetting the status quo. In this theory, the main propulsion of change is the evil motive of the Communist leaders. In the interpretation offered here, on the other hand, a rational (rather than evil) motive is ascribed to the leaders of both sides. The changes in the relative strength of coalitions is viewed as a normal political process. In both theories, the Soviet Union is interpreted as aggressive while the Western bloc is seen as a defender of the status quo. The difference between the theories is that, from the journalistic theory, one might infer that, were Communists to be replaced by liberals or democrats or aristocrats or kings, the aggression would cease. In the interpretation offered here, however, the aggression is a function of the total situation and would not be affected by a change of Eastern rulers except that perhaps kings might be less efficient aggressors than Communists.[9]

One might easily agree with Riker that a theory which attempted to explain East-West behavior solely in terms of a good-evil dichotomy would be much too simplistic. But it likewise appears too simplistic to explain the conflict on the basis of certain conclusions deduced from an $\underline{n}$-person, zero-sum model with side-payments. This seems especially true if by the use of such a model one concludes that the behavior of the East and West can be described as a "normal political process" in which the aggression of one side is seen as a "function of the total situation." Is not Riker's position a denial of the motivating force of ideology? Is it not possible that the aggressive character of a totalitarian regime is inherent in the system itself? Many scholars would say that an understanding of Soviet behavior, for example, must take into account at least the historical traditions and ideological forces of that nation.

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[9]Riker, The Theory of Political Coalitions, pp. 228-29. Emphasis added.

According to Hannah Arendt,[10] a totalitarian regime has as its ultimate goal world conquest. This goal, which is the essence of aggression, is a necessary aspect of any totalitarian regime, whether it is of the Nazi or Soviet type. According to Arendt, the totalitarians pursue this goal, not because of a desire to maintain or acquire a winning coalition. The program is carried out because a failure to do so would result in a loss of already existing power within the country itself. The maintenance of power within the home country entails the complete subjection of the individual and such subjection can be guaranteed only if global domination is acquired.

> The struggle for total domination of the total population of the earth, the elimination of every competing non-totalitarian reality, is inherent in the totalitarian regimes themselves; if they do not pursue global rule as their ultimate goal, they are only too likely to lose whatever power they have already seized. Even a single individual can be absolutely and reliably dominated only under global totalitarian conditions. Ascendancy to power therefore means primarily the establishment of official and officially recognized headquarters (or branches in the case of satellite countries) for the movement and the acquisition of a kind of laboratory in which to carry out the experiment with or rather against reality, the experiment in organizing a people for ultimate purposes which disregard individuality as well as nationality, under conditions which are admittedly not perfect but are sufficient for important partial results. Totalitarianism in power uses the state administration for its long-range goal of world conquest and for the direction of the branches of the movement; it establishes the secret police as the executors and guardians of its domestic experiment in constantly transforming reality into fiction; and it finally erects concentration camps as special laboratories to carry through its experiment in total domination.[11]

One can conclude, therefore, that to the extent a change from Communist (totalitarian) rulers to liberals or democrats would mean a change from a totalitarian regime to a non-totalitarian government, one could expect at least some change in the aggressive character of the Soviet Union. Of course, the implicit assumption being made here is that liberals or democrats do not demand the total subjection of the individual and thus would not have this particular demand as a basis for world domination. It is conceivable that some other basis would be found by the liberals or democrats for world domination, but such a line of reasoning is

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[10]The Origins of Totalitarianism (New York: Meridian Books, Inc., 1958).

[11]Ibid., p. 392.

rarely if ever propounded.

In their chapter entitled "The Totalitarian Dictatorship and the World," Carl J. Friedrich and Zbigniew K. Brzezinski also argue that the aggression of a totalitarian regime is inherent with the system itself and connected in a very definite sense with totalitarian ideology.

> ...Hitler set out for aggression and war....World-revolutionary appeals are an innate part of totalitarian dictatorship. They correspond to the "passion for unanimity" which these regimes display in their dealings with the people already under their control, and also indicate their inherent propensity for disturbing the peace. There can be little doubt that without an outward projection against a real or imaginary enemy, these regimes could not marshal the fanatical devotion which their system requires for survival. They are in a permanent state of emergency and cause other countries to be similarly afflicted.[12]

The authors conclude the chapter in the following manner:

> ...the dictator's aspiration to world rule is inseparable from the ideology of the movement and from the party which provides the framework for the dictator's operation in this as in other fields. It is, conversely, quite evident that the possibility for peaceful coexistence of the nations peopling this world presupposes the disappearance of the totalitarian dictatorships.... Any relaxation of the vigilance required to face such ideological imperialists as the totalitarians is likely to result in disasters such as the Second World War, or worse.[13]

Of course, neither these statements nor others like them[14] can **disprove** the conclusions of Riker's model; in fact, no attempt is being made to do so. One cannot disprove one statement merely by asserting another. Nevertheless, the over-simplified conclusions (or, perhaps more accurately, **implications**) of Riker's model point up a crucial factor concerning the use of logical models as a tool for investigating real-world phenomena. The point is this: the consistency of the model is no guarantee of its utility or empirical validity, especially in reference to particular instances. The construction of the model

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[12]_Totalitarian Dictatorship and Autocracy_ (New York: Frederick A. Praeger, 1961), p. 57.

[13]_Ibid._, p. 68.

[14]See, for example, Eric Voeglin, _The New Science of Politics_ (Chicago: The University of Chicago Press, 1952), pp. 114-17; Zevedei Barbu, _Democracy and Dictatorship_ (New York: Grove Press, 1956), pp. 202-03; Eric Hoffer, _The True Believer_ (New York: The New American Library, 1951), p. 86.

necessitates a simplicity of structure and concepts that may exclude those very factors necessary for an adequate understanding and/or prediction of the real world. Stokes implies that such is the case in Downs' model[15] and, in light of the above quotes by Riker, Arendt, etc., the same is true of Riker's model. The oversimplified assumptions are likely to lead to very general conclusions which will predict general tendencies on a large scale but cannot handle detailed events with much precision and accuracy.

Another factor affecting the hypotheses deduced from logical models is the requirement of being able to find empirical referents for at least some of the terms. In other words, if a model is devoid of all empirical content then the model would not be able to arrive at explanatory or predictive conclusions. This argument is clearly stated by Robert A. Dahl in his study, A Preface to Democratic Theory.[16] In the chapter entitled "Populistic Democracy" Dahl attempts

> ...to set forth an argument from which...the "absolute sovereignty of the majority" is sometimes derived.... [His task] ...is to make explicit certain assumptions and chains of reasoning that are ordinarily left implicit or tangential.[17]

His statement of the theory[18] of populistic democracy, therefore, provides no satisfactory criteria for determining who should be included in the system. As Dahl points out,

> to develop such satisfactory criteria requires careful attention to a host of empirical facts that are not specified in the system and, indeed, could not be without converting it from a system of pure logic to an empirical theory.[19]

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[15]"...we should treat as explicit variables the cognitive phenomena that the prevailing model removes from the discussion by assumption. Bringing these variables into the model would lessen its elegance and parsimony in some respects but would vastly increase the scientific interest of the model as a theory of party systems." Stokes, "Spatial Models of Party Competition," pp. 21-22. Stokes' analysis of Down's will be discussed below.

[16](Chicago: The University of Chicago Press, 1956).

[17]Ibid., p. 36.

[18]Dahl is using "theory" to refer to what has been defined in this study as "model." In fact, he refers to his statement of populistic democracy as "the model of populistic democracy." Ibid., p. 64.

[19]Ibid., p. 54. Emphasis added.

The fact that the model of populistic democracy is free of all empirical content means that the model "...however satisfying its logical symmetry, tell us nothing about the real world."[20]

In order for the model to "tell us something about the real world" it must be possible to translate the model—or, at least, its conclusions—into a theory. That is, it must be possible to define operationally at least some of the terms in the model.

The procedure for translating a model into a theory or, in other words, the procedure of interpreting the model, can be easily stated. Nothing more is involved than the act of designating the physical or empirical referents of the abstract terms or concepts in the model.[21] Duncan MacRae refers to this process as the "testing" of the model which involves the definition of the key concepts in the model and relating them to observation.[22] Downs, referring to the conclusions derived from the model, also admits the necessity of interpretation before the model can be applied to the real world. In a reply to a criticism leveled against his book, An Economic Theory of Democracy, Downs makes the following statement:

> ...the reasoning in my book remains largely within the framework of a model world....I did not "interpret" my conclusions by formally transferring them into the real world. However, I assumed that when I made a statement like "In two-party systems, parties closely resemble each other," the reader would not have to do much interpretation to apply it to the real world....[23]

The applicability of a model (including the deduced hypotheses) to reality depends, therefore, on designating the empirical content of the terms of the model. This does not mean, however, that there must be a one-to-one correspondence between all of the model terms and reality. As was pointed out in Chapter V, the only requirement is that,

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[20]Ibid., p. 47. See also, pp. 51, 59.

[21]Carl G. Hempel, "Operationism, Observation, and Theoretical Terms," Philosophy of Science, eds. Danto and Morgenbesser, p. 116.

[22]Dimensions of Congressional Voting (Berkeley, University of California Press, 1958), p. 354.

[23]Anthony Downs, "Dr. Rogers' Methodological Difficulties—A Reply to His Critical Note," American Political Science Review, LIII, No. 4 (December, 1959), p. 1096.

at least some of the terms include the essential aspects of the real situation under investigation.

Up to this point the analysis has been concerned mainly with indicating the necessity of designating the empirical referents of at least some of the terms in that aspect of the model that is to be tested, namely, the conclusions. However, if attention is drawn to the model as (1) an example of a hypothetical statement and (2) an example of a deductive system, one can conclude that the potential utility of the conclusions is enhanced if empirical referents can be found for the terms in the assumptions of the model as well as for the terms in the conclusions.

It is possible to describe the relationship between the model and its conclusions as an example of a hypothetical statement. A hypothetical statement is of the form "If...then...." The assumptions of the model--rational behavior, zero-sum, etc.--constitute the if-part of the statement (the antecedent) and the conclusions the then-part (the consequent) of the statement. This being the case, the truth of the antecedent implies the truth of the consequent (the testable hypotheses).

It is true, of course, that in a hypothetical statement, the antecedent could be false and the consequent true. However, as was pointed out in Chapter V, one can be more assured of the utility of the model if the terms or concepts in the model have some degree of relationship with the real world, i.e., if the terms include the "essential" aspects of the situation under investigation. In the construction of a model, therefore, one begins with the antecedent and the only way to insure that the consequent will be true in any given case is to assert the truth of the antecedent. Therefore, the terms "true" and "false" must be made applicable to the model itself in order to insure the truth of the conclusions. In light of the distinction noted above between model and theory this means that, keeping in mind the hypothetical nature of the model and its conclusions, one can say that the reasonableness of the assumptions of the model implies the reasonableness of the conclusions. The determination of the reasonableness of the assumptions of the model is an empirical problem. One could safely assume that a model whose initial assumptions were devoid of all empirical content or relevancy could hardly result in conclusions about the real world. However,

if one is convinced that a particular assumption of a model is reasonable (for example, that men act so as to maximize gains or are governed by the fiduciary relationship), then one has some basis on which to assume that the logical deductions of such an assumption are likewise reasonable.

On the other hand, the empirical validity of the assumptions can be established--at least partially--by the empirical validity of the conclusions. It is possible, for example, to disagree concerning the empirical validity of the utility-maximizing assumption of the various logical models referred to in this study. However, if the conclusions of a particular model based on this assumption are verified in the real world, then such an assumption must have some empirical validity.[24]

In any case, it seems beyond doubt, that the potential utility of a model as a tool for the investigation of the real world depends in a very basic sense on the ability to determine the empirical referents of the terms and concepts used in the model. In other words, it must be possible to translate the model into a theory. Furthermore, the greater the degree of empirical validity contained within the model, the more one can expect greater predictive and explanatory value for the conclusions of the model.[25]

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[24]Buchanan and Tullock, The Calculus of Consent, p. 266. A statement by I. Copi is relevant to this point. "We know very well that a valid argument may have a true conclusion even though its premises are not all true....So the inferred consequent might be true even though the premises from which it was deduced were not. In the usual case, though, that is highly unlikely; so that a successful or affirmative direct testing of a conclusion serves to render probable the premises from which it was deduced." Irving M. Copi, Introduction to Logic (New York: The Macmillan Co., 1953), p. 391.

[25]"Experience has shown in economics and in other social sciences that models based on the assumption of perfectly rational behavior often yield remarkably good predictions about the outcome of real-life social behavior, at least as a matter of good first approximation.

To be sure, we should be able eventually to obtain more realistic behavioral models of even greater predictive and explanatory value, by using...models of limited rationality, which explicitly specify the limitations to which all human information-processing and decision-making behavior is always subject, and which also explicitly specify how humans tend to adjust to these limitations in their own intellectual abilities." John C. Harsanyi, "Models for the Analysis of Balance of Power in Society," Logic, Methodology and Philosophy of Science, eds. Ernest Nagel, Patrick Suppes, and Alfred Tarski (Stanford: Stanford University Press, 1962), pp. 445-46.

This seems to be the main contention of Stokes' analyses of Downs' model. According to Stokes "...the usefulness of models depends abso-. lutely on the interchange between theory-building and empirical observation."[26] Although this statement is in accord with the general argument of this chapter, a closer examination of Stokes' position will indicate that he fails to account for some other aspects of the nature of logical models as a method for arriving at testable hypotheses.

In general, Stokes' article is a convincing argument that points out the non-empirical nature of the assumptions of Downs' spatial model; a spatial model being one in which "...a liberal-conservative dimension is stated on which parties maneuver for the support of a public that is itself distributed from left to right."[27] As Stokes points out, most spatial interpretations of party competition cannot be substantiated by empirical evidence.

The spatial model developed by Downs entails four assumptions which Stokes designates as (1) The Axiom of Unidemensionality, (2) The Axiom of Fixed Structure, (3) The Axiom of Ordered Dimensions and (4) The Axiom of Common Reference. When Downs treats the "space" over which parties contend (the liberal-conservative continuum) his model

> ...introduces assumptions about the one-dimensionality of the space, the stability of the structure, the existence of ordered dimensions and the common frame of reference of parties and e-lectorate that are only poorly supported by available evidence from real political systems.[28]

For the purposes of this study it is not necessary to analyze these assumptions in detail or to reiterate Stokes' evidence pointing out the fact that they cannot be empirically proven. The interesting point is that Stokes' empirical criticisms are leveled solely at the assumptions of the model and nowhere in his analysis does he direct his attention toward the specific conclusions deduced from Downs' model. His only comments directed toward the relationship of the assumptions of the model and its conclusions are of a very general nature. These comments can be summed up by saying that the more empirical validity that can be attributed to the assumption the more certain one can be of the empirical validity of the conclusions. Such a summary is, of course,

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[26]Stokes, "Spatial Models of Party Competition," p. 25.

[27]Ibid., p. 1. [28]Ibid., p. 5.

in keeping with the general argument of this study—especially when the model and its conclusions are considered as an example of a hypothetical statement.

But, if the model (Downs' model, for example) is seen as a tool for scientific research, then the <u>utility</u> of that particular model as a means for understanding or predicting the real world (in terms of its testable conclusions) must be considered. It would seem, therefore, that Stokes' empirical criticisms of Downs' assumptions would be of greater significance, if it were shown that the non-empirical nature of the assumptions adversely affected the utility of the long list of testable hypotheses stated as deductions of the model. In light of the fact that Downs never claimed empirical validity for the spatial model, Stokes' criticisms seem to be a moot point unless they can be related to the conclusions of the model. In other words, an empirical criticism of a particular model is valid only to the extent that it can be shown that the non-empirical nature of the assumptions limits the utility of the conclusions.

A consideration of the model as a deductive system also lends support to the view that an ability to define operationally the terms in the assumptions enhances the potential utility of the conclusions. Assuming that the model is valid, the terms in the conclusions must mean the same as they do in the premises. If the terms of the premises are admittedly abstract and, as such, do not include all of the factors of the real world, then the terms of the conclusion are likewise abstract and, therefore, have no actual empirical referents. To clarify this point, consider the following testable proposition stated by Downs. "Under certain circumstances, a rational man votes for a party other than the one he would most prefer to see in office."[29] If this is a valid deduction from the model then the term "rational man" means the same in the conclusion as in the premises of the model. Furthermore, if the proposition is truly testable then the term "rational man" must have an empirical referent. The very nature of the model, however, precludes this possibility because "rational" is an abstract term in

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[29]Downs, <u>An Economic Theory of Democracy</u>, p. 298.

the model and by definition and Downs' admittance the whole personality of the individual is not considered in the definition of the concept.[30] Strictly speaking, therefore, the term "rational man" as defined in the model has no empirical referent and, accordingly, the proposition is not testable.

Although such a line of argument is logically valid, it is not of crucial significance. Previously, the use of abstract terms in logical models was justified mainly in light of the potential utility of the model as a tool for investigating political phenomena. Although particular terms may be abstract they may still contain the essential aspects of the situation under investigation and be useful for understanding the problem. The utility of Downs' model may likewise be sufficient to warrant overlooking the strict logical implications of the use of abstract terms which mean the same in the premises as in the conclusions.

One way of avoiding the objection mentioned above is to make an explicit distinction between the logical conclusions of the model and the interpretation of those conclusions into empirical statements. This is the procedure adopted by Riker, and in light of the difficulties mentioned above in testing the logical conclusions of abstract deductive systems, such a procedure seems worthy of imitation in the construction of future models in political science. Perhaps an example of Riker's method will help to clarify the exact procedure.

The model, based on the axioms of n-person, zero-sum, results in the following logical deduction.

> In n-person, zero-sum games, where side-payments are permitted, where players are rational, and where they have perfect information, only minimum winning coalitions occur.[31]

Instead of attempting to test empirically such a conclusion (which would bring up such problems as finding the empirical referents for a zero-sum condition, rational players, etc.), Riker proposes to translate this statement into "...a descriptive statement, or sociological law,

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[30] Ibid., p. 7.

[31] Riker, The Theory of Political Coalitions, p. 32.

about the natural world...."[32] Empirical evidence is then adduced to
verify it. The translation of the logical deduction is stated as fol-
lows:

> In social situations similar to n-person, zero-sum games with
> side-payments, participants create coalitions just as large as
> they believe will ensure winning and no larger.[33]

It seems obvious that the possibility of verifying the latter statement
would pose far fewer problems than would be the case for the former.

Although the use of logical models to generate testable hypotheses
poses many problems, the utility of any particular model in relation to
its conclusions can be determined.

In consideration of the hypotheses deduced from the model, a use-
ful model is one from which significant, non-obvious conclusions can be
deduced. In other words, a useful model is one which results in hypo-
theses that would not have been discovered without its use. However,
if a model does result in non-obvious hypotheses these hypotheses must
also be significant; that is, they must be able to tell something about
the real world.[34]

Naturally, the determination of whether or not the conclusions of
a particular model are non-obvious and significant is an empirical
question and, as such, outside the strict limits of this study. How-
ever, a few brief comments on the conclusions of the general models
discussed in this study may be beneficial to a more adequate understand-
ing of the use of logical models in political science.

According to Downs, his model

> ...can perhaps be used to discover (1) in what phases of politics
> in the real world men are rational, (2) in what phases they are
> irrational, and (3) how they deviate from rationality in the lat-
> ter.[35]

At the end of his book Downs enumerates a list of propositions derived
from the model which he says are possible of empirical testing. By
the author's own admission,[36] however, few (if any) of these conclusions

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[32]Ibid.   [33]Ibid., pp. 32-33.

[34]Anthony Downs, "Why the Government Budget is too Small in a
Democracy," World Politics, XII, No. 4 (July, 1960), p. 563; Riker, The
Theory of Political Coalitions, p. 23; Rapoport, American Political Sci-
ence Review, LII, No. 4, p. 976.

[35]Downs, An Economic Theory of Democracy, p. 33.   [36]Ibid., p. 14.

are new. It would seem, therefore, that even if the model were success-
ful in determining "in what phases of politics in the real world men
are rational" etc., the model would not be resulting in non-obvious
conclusions. In any case, the testable hypotheses deduced from the
model are clearly stated by Downs and therefore available for examina-
tion in the light of the non-obvious-significant criterion.

The testable hypotheses of the Buchanan-Tullock model, however,
are not available in a list form for easy observation and evaluation.
As the authors state, "...we do not intend to develop in any exhaustive
way the operational implications of our analysis...."[37] Nevertheless,
the significance of the conclusions of the model can be determined to
some extent. This can be done by reviewing the authors' discussion of
the relationship between their model as a logical construct and its
operational implications.

In agreement with the analysis presented in this study, the au-
thors state that the conclusions of the model are absolutely dependent
upon the assumptions of the model and, as such, the concepts of "truth"
or "falsity" do not apply to the model. The only procedure for verify-
ing the assumptions of the model involves the comparison of the impli-
cations or conclusions of the model with the real world.[38] But, as the
authors point out, if the model results in conclusions or predictions
that are true in every conceivable case, then the model is of no sig-
nificance at all. In other words, to assert the operational validity
of the model and its generated hypotheses it must be possible to show
that there are conceivable observations that would refute the assump-
tions of the model.[39]

The authors then proceed to state what would be considered as evi-
dence against the assumptions of the model.

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[37]Buchanan and Tullock, The Calculus of Consent, p. 292.

[38]Such a comparison assumes, of course, that the terms and rela-
tionships in the model can be translated into a theory about the real
world.

[39]"The chief distinguishing characteristic of scientific hypo-
theses (as contrasted with unscientific ones) is that they are testable.
That is, there must be the possibility of making observations which tend
to confirm or disprove any scientific hypothesis." Copi, Introduction
to Logic, p. 392. Emphasis added.

If, for example, we should observe <u>a social group operating under less inclusive rules for constitutional change than for day-to-day operational decisions</u>, this would seem clearly to refute the central hypothesis of our theory. If we should observe <u>single groups deciding unilaterally to give up special privilege legislation</u>, our hypotheses are refuted. If we could observe <u>the oil industry pressure group petitioning Congress for an elimination of the depletion allowance</u>, if we could observe <u>the American watchmakers unilaterally petitioning</u> the President <u>to lower the tariff rates on Swiss</u> and Japanese <u>watch imports</u>, if we could observe <u>the California farmers</u> actively <u>opposing federal irrigation projects</u>, then we should have clear evidence that some conception of the political process alternative to our own should be sought.[40]

The fact that such evidence (for example, a group giving up special privilege legislation) is only remotely possible suggests the empirical validity of the assumptions of the model. But if it is true that the observation of a group operating under a less inclusive rule for constitutional change (a simple majority rule, e.g.) than for day-to-day decisions (a 3/4 rule, e.g.) would refute the central hypothesis of the model, then one could say that the implications of the central hypothesis is that groups do not act in such a manner. In other words, the implication or deduction of the central hypothesis is that groups operate under a more inclusive rule for constitutional choice than for day-to-day matters. Using the above quote as a basis, one can conclude that the deductions of the model are (1) social groups use more inclusive rules for constitutional change than for day-to-day operations, (2) single groups do not unilaterally give up special privilege legislation. Because the authors state that they do not intend to develop an exhaustive list of deduced hypotheses, it would not be accurate to say that the above are the <u>only</u> two possible testable hypotheses of the model. On the other hand, however, these two hypotheses are indicative of the type of testable conclusions that are <u>logically</u>[41]

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[40]Buchanan and Tullock, <u>The Calculus of Consent</u>, pp. 299-300. Emphasis added.

[41]It might be claimed that the model also results in such testable conclusions as (1) expected external costs decrease in a social group if the decision-making body in that group increases in size, and (2) expected external costs increase as the decision-making group decreases. Although it may be possible to test empirically such statements, the argument of this study has been that such conclusions are <u>not logically</u> deducible from the stated assumptions of the model.

deducible from the model. The significance and non-obvious nature of such conclusions is not readily established. (This is not to say, however, that the use of the model is devoid of all utility. In fact, the employment of the model to <u>analyze the concepts</u> of majority rule and the two-house legislature has already been stated as a beneficial or insightful application of the model.)

The conclusions of the Riker model appear in a better light than the conclusions of either the Downs or Buchanan-Tullock model. At least two reasons account for this fact. On the one hand, the subject matter of the model (the formulation of political coalitions) is much narrower than the topics of Downs' model or that of Buchanan and Tullock. Because the model does not attempt to provide a behavioral rule for democratic government (Downs) or establish the logical foundations of constitutional democracy (Buchanan and Tullock), the deductions of the model do not tend to be more inclusive than warranted by the assumptions of the model. Secondly, because Riker has made a conscious distinction between the logical deductions of the model and the translation of these deductions into empirical statements, it is much easier to determine what Riker considers to be the empirical conclusions of the model. In brief, these conclusions can be summarized as follows: (1) If the members of various coalitions know who belongs to each coalition, then winning coalitions tend toward the <u>minimal</u> winning size. (2) Participants in the final stages of coalition-formation move toward a minimal winning coalition. (3) In situations where (1) and (2) are operative the system is unstable, i.e., decisions are made regardless of stakes and hence participants are eliminated.[42] These conclusions are both logical deductions of the (translated) model and capable of empirical testing. They are neither more inclusive than the assumptions warrant nor do they contain terms or concepts having no empirical referents.

As in the cases of the Downs and the Buchanan-Tullock model, the significant, non-obvious nature of these conclusions is an empirical matter. Even without attempting to evaluate empirically these conclusions in light of the significant, non-obvious criterion one can conclude

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[42]Riker, <u>The Theory of Political Coalitions</u>, pp. 211-12.

that they seem to meet the test better than the conclusions of the two former models. Downs admits that few of his conclusions are "new" (non-obvious). Furthermore, the statement that coalitions tend toward a **minimum** winning size seems more significant and less obvious[43] than the statement that groups do not give up special interest legislation.

Summary

It must be emphasized once again that the final determination of the significant non-obvious nature of the testable conclusions of logical models is an empirical matter. No attempt is being made here to evaluate conclusively the conclusions of the three general models. The aim has been, however, to indicate the minimum conditions under which one can expect that the logical conclusions of a (translated) model will be testable and at the same time significant and non-obvious. The conditions are as follows: (1) It must be possible to translate the logical deductions into theories. In other words, one must be able to designate the empirical referents of at least some of the terms used in the model. (2) Since the conclusions under consideration are the **logical** deductions of the model, the conclusions must be valid deductions which means, of course, they may not be more inclusive than warranted by the assumptions. (3) Although the model does not have to include all aspects of the real world, it must be assumed that at least the essential aspects are included.

There is no guarantee that models which meet these three conditions will necessarily result in significant, non-obvious conclusions. On the other hand, it seems unlikely that models which fail to meet the conditions will produce logical deductions of a significant, non-obvious nature. The conditions, therefore, are necessary but not

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[43]Riker argues that the size principle is not an obvious truism, although it may appear so at first glance. "...if one considers that Downs, An Economic Theory of Democracy...is based on two axioms, one of which is in partial contradiction with the [principle] , then the non-obvious character of the generalization is apparent. Downs assumed that political parties (a kind of coalition) seek to maximize votes = (membership). As against this, I shall attempt to show that they seek to maximize only up to the point of subjective certainty of winning. After that point they seek to minimize, that is, to maintain themselves at the size (as subjectively estimated) of a minimum winning coalition." Ibid., p. 33.

sufficient. Furthermore, it would be impossible to state the sufficient conditions for a model resulting in significant, non-obvious conclusions for the same reason that it would be impossible to state the sufficient conditions for a mathematical system useful for investigating the real world. Because there is always some doubt about what are the influential variables of a real world situation, the door must always remain open for the possibility of a new or different system that may prove useful. Past experience may indicate what are the minimum conditions for a potentially useful system or model, but past experience can never dictate the sufficient conditions.

Although the sufficient conditions cannot be stated, it has been shown that the potential utility of the conclusions is enhanced if empirical referents can be found for the model as well as for its conclusions. This argument was substantiated by the analysis of a logical model as an example of a hypothetical statement and as an example of a deductive system.

CONCLUSIONS

For some time to come the reaction to political models is likely to depend partly on taste. So few formalizations have added to our knowledge of politics that their potential value can be a matter for honest debate.[1]

The lack of a general consensus in the discipline about the potential utility of logical models for the investigation of political phenomena is not surprising. A survey of virtually any study of the history of science will give ample evidence for the fact that most new techniques or methods are considered suspect until time has proven otherwise. Nevertheless, the aura of doubt that surrounds the use of logical models in political science is founded upon some substantive problems inherent in the attempt to apply abstract deductive systems to the real world--a world that is, by definition, neither abstract nor amenable to explanation solely in terms of logically connected deductive propositions. This study has been, in part, an attempt to state these major substantive problems.

The first difficulty that must be met in the use of logical models in political science stems from the deductive nature of such models. Considered as a deductive system, the conclusions of a logical model may be only about the model itself and have no relevancy to the real world. In other words, a deductive system is a self-contained system for which the terms "true" and "false" are not applicable. Conclusions derived from such a system are <u>strictly speaking</u> nothing more than the logical implications of the original assumptions of the model.

This difficulty which is inherent in the model itself as a deductive construct is further compounded to the degree that the model incorporates abstract terms and relationships. The use of abstract terms raises the problem of determining the empirical referents of such terms-- a problem that must be solved if the conclusions of the model are to have potential utility as explanatory or predictive hypotheses about actual political situations or events.

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[1]Stokes, "Spatial Models of Party Competition," p. 25.

Third, it has been shown that the deductions of any particular model are true only if (1) the deductions from the model are valid and (2) the postulates in the model include the essential properties and relationships of the real world situation under investigation. The inability of a model to meet the two above stated conditions severely limits its potential utility.

The limitations of logical models arising from their deductive, abstract nature can be overcome (at least in part) if still another problem can be solved. This latter problem is an empirical one and involves the assumption that the abstract terms and simplified relations or structures of the model do, in fact, include the essentials of the situation or phenomenon under investigation.

Although the use of logical models in political science is beset with problems and is limited in its scope of applicability, such models can serve useful functions. A partial aim of this study has been an attempt to state clearly both the limitations and the valid use of logical models in political science.

First, it has been shown that the use of a logical model in the investigation of a complex situation (the relationships between nation states, the behavior of parties and voters in various party systems, decision-making and coalition formulation--to mention but a few) may result in simplifying the problem into a more manageable form. Logical models can function in this manner because the models incorporate only the essential aspects of the problem, leaving out those factors or variables of a more superficial nature. Assuming that a model does, in fact, include the essential properties and relationships of the real world, one can conclude that the construction of a model results in a simplified, clear statement of a complex situation or problem.

Second, the construction of a logical model, if valid, helps to clarify the logical implications of the initial postulates or concepts of the model. In this sense, the model acts to make explicit the implicit assumptions and ramifications of the model. The resulting clarification can be considered as an end in itself or, the model may be compared to reality and thereby suggest hypotheses which can account for the differences and/or similarities between the model and reality. The analysis presented in this study indicates that the use of models

as a basis with which to compare reality is more closely identified with normative models. However, it is possible for a logical model (a model constructed mainly for the purpose of deducing hypotheses) to function in a similar manner. In other words, the definition of a logical model included the statement that such models result in deduced hypotheses, but the definition does not preclude the possibility of using them for another purpose.

Third, the construction of a logical model results in testable hypotheses; hypotheses that may help in an understanding of the phenomenon under investigation. Furthermore, such hypotheses may be non-obvious and may come to light only by the use of a simplistic construct that deals with the logical relations of the essential aspects of the situation. Ultimately, the final evaluation of the deduced testable hypotheses of logical models is an empirical matter. Although such an empirical evaluation has not been the aim of this study, the following three conditions are necessary in order to assert the (potential) utility of testable hypotheses deduced from abstract logical systems. (1) The model and its conclusions must constitute a valid deductive system. (2) The conclusions must actually work in practice (that is, they must be useful for an understanding of the real world) even though they are founded on (or deduced from) abstract assumptions. (3) The distortions in the initial assumptions of the model must be assumed irrelevant to the empirical problem for which the model is constructed.[2]

The literature of the discipline indicates clearly the prolific use of models of all kinds and descriptions. This study has been an attempt to sort out the various uses of the term "model" and to suggest two types--normative and logical--under which one can place the models of international relations, Supreme Court behavior, etc. It is hoped that the definitions for these two types can be useful in clearing away the ambiguity surrounding the term "model" in political science.

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[2]Conditions (2) and (3) could be subsumed under the condition stated in chapter vi requiring that the model and its conclusions be capable of being translated into a theory.

For the conditions necessary in order to defend game theory (i.e., "fictional problem-solving models") as a tool for empirical research see, Harvey Wheeler, "The Political Limitations of Game Theory," The Western Political Quarterly, X, No. 3 (September, 1957), p. 669.

Whether or not the continued use of logical models in political science is worth the effort needed in their construction will depend on two factors. First, are the results of their employment significant and non-obvious? Second, although it is fortunate that the rules of logic and the functioning of the empirical world <u>to some extent</u> coincide, the utility of logical models for investigating the real world will depend in part upon assessing that extent of correspondence.

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