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THEORETICAL GEOGRAPHY

BY

WILLIAM BUNGE

THE ROYAL UNIVERSITY OF LUND, SWEDEN
DEPARTMENT OF GEOGRAPHY
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CHAPTER ONE

A GEOGRAPHIC METHODOLOGY

The discussion of methodology presented here attempts to relate geography to science. The province of the discussion extends past the consideration of scientific theory alone since it is necessary to establish the relationships between theory and other aspects of science, especially between theory and fact (description) and theory and logic (mathematics). The first section introduces a general philosophy of science with emphasis on the place of theory. The next section discusses two problems involved in considering geography as a science. These two problems concern the role of description in geography and the predictability of geographic phenomena. The third and last section, which draws heavily from Schaefer,[1] suggests a scientific methodology for geography and outlines the relationships between regional and descriptive, systematic and theoretical, and cartographic and mathematical geography.

In order to view the methodology in the perspective intended, certain ground rules should be kept in mind. Historical arguments supporting or attacking methodological positions are not utilized. Contemporary rather than earlier geographic literature is cited because it contains the accumulated wisdom of geography. In addition, the earlier geographic literature is not cited because the great men of our past might now, in view of more recent events, hold opinions different from those they held. Though contemporary literature is useful, the ultimate test of a methodological position is its ability to produce substantive results. The iron question is, "Does the methodology lead to fruitful geographic research?" a question to be answered in part in subsequent chapters, not here.

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[1] Fred K. Schaefer, "Exceptionalism in Geography: A Methodological Examination," *Annals*, Association of American Geographers, Vol. 43 (1953), pp. 226—49.

I. A GENERAL PHILOSOPHY OF SCIENCE — THE ESSENTIAL ROLE OF THEORY

It is useful to divide science into three elements: logic, observable fact, and theory. Logic includes mathematics and has to do with the relations between symbols. Logical systems make no statements about the real or factual world. Observable facts must be designated operationally, because it is only by exact description of how an observation is made that we can identify a particular fact. A theory is formed by the union of logical system with operationally defined facts. Theory is the heart of science because scientific theory is a key to the puzzles of reality. It is discovered, not blindly as Columbus discovered America, but with great ingenuity and inventiveness, as one discovers a rule to escape from a maze. It has the power, indeed requirement, to predict. If a theory can not predict it has not discovered a rule of reality. The creation of theory is difficult because the scientist must successfully identify the purely logical symbols of mathematics with a set of observable facts.

A. STANDARDS A THEORY MUST MEET

To be effective, a theory must meet certain standards including clarity, simplicity, generality, and accuracy. Clarity is achieved when a theory is presented in a mathematical form because the mathematical form assures explicitness as well as freedom from contradiction. Language has a logical structure and can provide a frame for sensible statements. However, verbalized theory tends to be incomplete-explicitness and freedom from contradiction is not assured. Thus, science, striving for clarity, ultimately is forced to use mathematical forms. As Richardson states:

> The magnificent conception of mathematics as the study of all abstract logical systems or abstract mathematical sciences and their concrete interpretations or applications really justifies the statement that mathematics is basic to every subject forming part of the search for truth. In fact, mathematics, thus conceived, includes all subjects into which one injects logical structure. "To *mathematize* a subject does not mean merely to introduce equations and formulas into it, but rather to mould and fuse it into a coherent whole, with its postulates and assumptions clearly recognized, its definitions faultlessly drawn, and its conclusions scrupulously exact."[2]

[2] Moses Richardson, *Fundamentals of Mathematics* (New York: The Macmillan Co., 1958), p. 481.

Kemeny makes the same essential point from a different vantage. He says:

> CAN ALL SCIENCES USE MATHEMATICS? The answer is "Yes." What is more, they *must* use Mathematics.
> But you will often find the claim that the physical sciences are mathematical and the Social Sciences are nonmathematical. The reason for this misunderstanding is that people associate Mathematics with numbers. While I am quite certain that numbers will play a fundamental rôle in all these sciences soon, I want to maintain more, namely, that all scientific theories — numerical or other — are mathematical. This fact rests on the nature of Mathematics, on its identity with advanced logic.[3]

The other three standards — simplicity, generality, and accuracy — are intimately related. Simplicity is gained by minimizing the variables. Generality is produced by broadening the scope of the information contained. Accuracy is achieved by becoming wholly specific. Tension arises in that simplicity and generality tend to produce inaccuracy. In fact, no theory conforms exactly to observed facts. The constant dissatisfaction with the simplicity, generality, and accuracy of present theory leads to new theoretical work. A theory, no matter how deficient, is not abandoned, however, until a better one is produced.

B. PLAUSIBILITY — A FALSE THEORETICAL STANDARD

Contrary to widely held opinion, the plausibility or intuitive reality of a theory is *not* a valid basis for judging a theory. The discarding of this common-sense notion has had a vital effect on the acceleration of progress in both modern science and mathematics. As Frank writes:

> . . . setting up principles from which we can derive observable facts and applications of observed facts — is what we call "science" today. "Science" is not much interested in whether these principles are plausible or not.[4]

This concept is difficult to grasp since it contradicts everyday experience. Perhaps it can be more easily grasped if some additional characteristics of theory are examined. Multiple theories that deal with a single phenomenon can coexist in science if they match the observable world. Which one of several theories is more plausible is a question that is never asked.

[3] John G. Kemeny, *A Philosopher Looks at Science* (Princeton, N.J.: D. Van Nostrand Co., 1959), p. 33.

[4] Philipp Frank, *Philosophy of Science* (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1957), p. 13.

This difficulty regarding the plausibility — the intuitive reality — of theories trapped Kant. He claimed that humans are born with certain powers to discern the real from the unreal. He used as his prime example the alleged irrefutable and exclusive reality of Euclidean geometry! In spite of the rejection of Kant's view concerning plausibility, the notion still lingers. Plausibility appears to be no more than familiarity since standards vary from generation to generation. Newton's theories are considered *real* and *plausible* in our day, but they were thought to be unreal and implausible in his own time.

The essential pragmatic question regarding plausibility is, "Can scientists hope to borrow successfully theories originally invented in foreign fields of knowledge?" Certainly, implausible though it may appear. It is an observed fact that once theory is produced it often can be applied to a variety of subjects. In this sense, there is a unity to knowledge. To give this assertion substance, some examples appropriate to geography are offered.

Consider Enke's paper, "Equilibrium among Spatially Separated Markets: Solution by Electric Analogue."[5] Can electricity be expected to behave like a spatial economic system, as he insists? Yes, because it has been found that the underlying mathematics can be translated into certain carefully selected aspects of both subjects. A second illustration of the borrowing of theories is available from Beckmann's "A Continuous Model of Transportation."[6] It is suggested by hydrodynamics. Can water be expected to behave like a spatial economic system? Again, it is the mathematics that can be made to fit features of both sets of phenomena. If social scientists are somewhat defensive because they have been borrowing heavily from mathematics and from theory first used in other fields, they can draw some comfort from the knowledge that there is reciprocity. Programming, first applied in social science, is now being used in designing electric networks.

A theory originally formulated in one field is usually modified when it is applied in another field. For instance, Richards in "Shock Waves on the Highway"[7] makes a radical departure from the Newtonian theory that directly inspired his theory. He eliminates the concept of mass and defines velocity as being inversely related to density; i.e., the more crowded the vehicles on the highway, the more slowly they move. In spite of such radical alterations it may be easier for the scientist to imagine new theory to be an aspect of an old theory, even to the point of retaining the vocabulary of the original. Actually, in doing so he is attempting to relate the implicit abstract logic of one theory to another where he believes their realities are similar. All is fair in theory construction. Researchers who refuse to borrow at least parts of theories from other fields put themselves at an unfortunate disadvantage. Only the world's greatest intellects are able to discover a radically new approach. It can even be argued that analogous theories are superior since they simplify our knowledge and therefore should be deliberately sought.[8] This does not give researchers license to argue loosely through verbalized analogy. Certainly theory ultimately must weld observable facts rigorously to mathematics so that the theory is sufficiently explicit to be testable, and tests against the world of facts must be performed to determine the theory's merit.

Scientific theory, the heart of science, is an exchange between concept and percept. Scientists seek convenient generalizations that match the observable world, and any notion of plausibility is considered metaphysical.

II. TWO PROBLEMS INVOLVED IN CONSIDERING GEOGRAPHY AS A SCIENCE

Methodological analysis is centered on the question of the relationship between geography and science. There is no dispute here with what appears to be the concensus of American geographers over confining the subject matter of geography to the earth's surface[9] and to phenomena of human significance. This agreement immediately lends vast unity to geography. The arguments presented deal with how the subject is to be treated.

There are two particularly bothersome problems in treating geography as a science. The first problem is concerned with the role of

[5] Stephen Enke, "Equilibrium among Spatially Separated Markets: Solution by Electric Analogue," *Econometrica*, Vol. 19 (1951), pp. 40—47.

[6] Martin Beckmann, "A Continuous Model of Transportation," *Econometrica*, Vol. 20 (1952), pp. 643—60.

[7] Paul I. Richards, "Shock Waves on the Highway," *Journal of the Operations Research Society of America*, Vol. 4, No. 1 (1956), pp. 42—51.

[8] Morris R. Cohen and Ernest Nagel, *An Introduction to Logic and Scientific Method* (New York: Harcourt, Brace & Co., 1934), pp. 221—22.

[9] It might be pedantically neat to refer to the earth's surface as "the planet earth minus its interior." To allow for the space age and the possible penetration of the earth's crust by explorers the statement might be modified to read, "that portion of the universe directly available to man."

description in geography and the second with the predictability of geographic phenomena.

A. THE ROLE OF DESCRIPTION IN GEOGRAPHY

A methodological issue frequently raised in geography concerns the function of description. The issue takes two forms. First, is description scientific? And second, is description peculiarly geographic?

Some take the position that description is non-scientific.[10] This position cannot stand. There is an infinitude of facts around us and any description of them is highly selective. This selection can be made at random, but geographers are always seeking facts they judge to be significant. Significance can be judged only in relation to some other phenomenon. The establishment of this relationship means that theory has been formulated. The so-called "mere describers" in geography do not go out into the world with empty heads. They have the *feel* of an area and a well-developed spatial intuition. This means that they possess theory, though it might be vaguely formed, implicit, and perhaps subconscious. Out of this process of describing has come increasingly explicit and rigorous theory. There is no escape. Description, by its very nature, is scientific.

Still there are real operational differences between those interested in description and those interested in "science." While the former, thinking through classificatory schemes, spend some effort on implicit theory, they spend more of their effort on inventory, completing their classification. Their work becomes repetitious. They will, of course, discover as many categories and classes in their classification as they seek. Their expectation is that some day, some way, someone will find these results invaluable. In contrast, the "scientists" concentrate their efforts more on ideas and imagination. Ironically, they are much less interested in statistics, in the sense of the *World Almanac*, than the "describers." The "scientists" are, however, heavily involved with mathematics — often highly abstract mathematics — which they use as framework for their theories. They imagine more and repeat less.

Lukermann and others feel that geography is peculiarly descriptive and description deserves a favored place in geographic research. He writes:

> A more geographic economic geography would start from observations with the recording of data on maps. Research in geography would begin with the description of the geographic phenomena and associations so arranged and ordered. . . . Description so stated has as its culminating study the investigation of process, and geographic research thus defined would prescribe a synoptic as well as an analystic [sic] approach. The formulation of theory and model building in geography would serve only heuristic ends; furthering investigation of empirical observations.[11]

There is in geography, as in any other science, a continuous interplay of logic, theory and fact (description). One cannot be separated from the others. Due to their inseparability, it is absurd to claim that one, in this case description, is "more geographic" than the others. All are geographic. The problem in geography, as in any other science, lies in trying to find more and more economical ways of ordering our perception of facts. In this constant search for efficiency, it must be asked, "Where is the bottleneck?" Without hesitation it can be answered that it lies in the construction of theory. In this connection Berry says:

> . . . Is it valid to argue that "Research in geography would begin with the description of geographic phenomena and associations so arranged and ordered?" This is a common view expressed frequently in methodological notes in geography. It is apposite to ask whether continued emphasis upon description is efficient. As Zetterberg remarks, "The quest for explanation is the quest for theory." . . . observation is necessarily proceeded [sic] by the hunch or hypothesis which needs to be tested against reality, by problem-orientation rather than by inventory.[12]

B. THE PREDICTABILITY OF GEOGRAPHIC PHENOMENA

The question of predictability is crucial since it is the basic assumption of all theory. The predictability of geographic phenomena depends in turn on the answer to a question: Are geographic phenomena unique or general? If they are unique, they are not predictable and theory cannot be constructed. If they are general, they are predictable and theory can be constructed. The clarification of this issue may be drawn from the philosophy of science. Science assumes phenomena to be general, not unique. Whether a phenomenon is unique or general can be considered to be a matter of point of view or of the inherent property of the phenomenon itself.

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[10] F. Lukermann, "Toward a More Geographic Economic Geography," *The Professional Geographer,* Vol. 10, No. 4 (1958), pp. 2—10.

[11] *Ibid.*, pp. 9—10.

[12] Brian J. L. Berry, "Further Comments Concerning 'Geographic' and 'Economic' Economic Geography," *The Professional Geographer,* Vol. 11, No. 1, Part 1 (1959), p. 12.

1. *Uniqueness as a Point of View*

Imagine that we are extremely acute observers; then, if we look closely at any two objects we will find them to be totally different because *every* property investigated will be found to be different. Suppose we are considering two white rocks. Are they identical in color? Of course not. Then calling them both white is an error. Certainly, if we look closely at all rocks we will find that no two have exactly the same color. So in order to be accurate, the color of each rock needs a special identifying name. But rather than invent a name for the color of every rock in the universe, we can save much work by indicating the rock to which we are referring and pronouncing "Its color is thus." The same reasoning applies to the concept of rock. No two rocks are identical. Then, for accuracy, we should not use the word "rock" but have an individual name for each object. By admitting that no two objects are exactly alike we end up abandoning our language and pronouncing, "Things are thus." Therefore, according to the doctrine of uniqueness, nothing can be described, much less explained or predicted.

This chain of reasoning leads to a conclusion probably so unpalatable to most readers that they might look for some error in it. But this reasoning is one of man's great intellectual achievements.

Bergson writes:

> . . . Were all the photographs of a town, taken from all possible points of view, to go on indefinitely completing one another, they would never be equivalent to the solid town in which we walk about. Were all the translations of a poem into all possible languages to add together their various shades of meaning and, correcting each other by a kind of mutual retouching, to give more and more faithful image of the poem they translate, they would yet never succeed in rendering the inner meaning of the original. A representation taken from a certain point of view, a translation made with certain symbols, will always remain imperfect in comparison with the object of which a view has been taken, or which the symbols seek to express. But the absolute, which is the object and not its representation, the original and not its translation, is perfect, by being perfectly what it is.[13]

This is the doctrine of *uniqueness.* It is consistent, logical, and unscientific.

Science is diametrically opposed to the doctrine of uniqueness. It is

[13] Henri Bergson, *An Introduction to Metaphysics* (New York: The Liberal Arts Press, 1950), pp. 22—23.

willing to sacrifice the extreme accuracy obtainable under the uniqueness point of view in order to gain the efficiencies of generalization. Therefore, science will accept the class "white rocks." Science is cheerful in that it assumes it can become constantly more general and more nearly accurate through its inventive efforts, though it realizes it can never become completely accurate. Since inaccuracies can always be reduced, science does not ascribe the ever-present existence of these inaccuracies to uniqueness, but to the state of the art.

2. *Uniqueness as an Inherent Property of Objects*

Hartshorne has written recently on the subject of uniqueness as an inherent property of objects. His statement is so clear and typically thorough that it is necessary to draw mainly on his arguments knowing full well they are not peculiar to him.

Hartshorne confuses *unique* with *individual* case. Individual case implies generality, not uniqueness. For example, assume there is a theory that explains the existence of islands. There is only one Manhattan Island. Yet, if Manhattan Island conforms to the theory of islands, it is different from other islands only in that the variables are in peculiar quantitative combination. Manhattan Island is an individual case, as are all other islands, and the theory is still applicable. Thus individual case, properly defined, cannot be opposed to generality; yet Hartshorne writes, "It may facilitate understanding if we speak more simply of generic studies in contrast to studies of individual cases." [14]

Hartshorne explicitly takes the position that "every case is unique." This appears to contradict his statements regarding generality. Perhaps he means every case is partly unique and partly general in the sense that no events can be exactly predicted. If this is what he intends, there is no disagreement, but this is not what he writes. He comments:

> Literally, the term "nomothetic" refers to the search for general laws, as opposed to "idiographic," the intensive study of an individual case, but I agree with Ackerman that any generic concepts, whether or not leading to scientific laws, should be considered as contrasted with "idiographic" as the intensive study of the individual case. In translating the latter term (which is not to be confused with "ideaographic"), I have found that to speak of the study of "unique cases," though correct in the sense that every case is unique, may be misleading in suggesting the sense of "rare" or "unusual."[15]

[14] Richard Hartshorne, *Perspective on the Nature of Geography* (Chicago: Rand McNally & Co., 1959), p. 149.

[15] *Ibid.*

Hartshorne's difficulty over this point is fundamental. Also, unique is so rare and unusual as to be singular.

He also feels that the qualities of uniqueness and generality are inherent qualities that reside in objects and that they help account for the success or failure of geography to establish theories. Hartshorne writes:

> The fact that geography is one of the fields of knowledge in which a comparatively large amount of effort is spent in studying individual cases rather than constructing scientific laws has been a matter of concern to critics within our midst for more than half a century. Before concluding that drastic changes are in order, it will be well to consider to what degree this may be a necessary consequence of the nature of our subject.[16]

This attitude is crippling because it leads us to distinguish between the unique and the general by the following process. If we have been able to construct theory involving phenomena, the phenomena are general. But if we have not been able to construct theory, it is because the phenomena are unique. Since unique phenomena cannot be explained, there is no sense in attempting to develop generalities. Thus, we are defeated before we try.

Schaefer has a strong grip on the problem of uniqueness.

He writes:

> The systematic geographer, studying the spatial relations among a limited number of classes of phenomena, arrives by a process of abstraction at laws representing ideal or model situations; that is, situations which are artificial in that only a relatively small number of factors are causally operative in each of them. Practically, no single such law or even body of laws will fit any concrete situation completely. In this noncontroversial sense every region is, indeed, unique. Only, this is nothing peculiar to geography.[17]

And,

> The main difficulty of the uniqueness argument is that, as Max Weber has pointed out, it proves too much. Are there really two stones completely alike in all minute details of shape, color, and chemical composition? Yet, Galileo's law of falling bodies holds equally for both. Similarly, limited as our present psychological knowledge is, it seems safe to say that no two people would register identical scores on all tests as yet devised. Does it follow that our psychologists have so far discovered not a single law? What it all comes down to is a matter of degree.[18]

[16] Hartshorne, *op. cit.*, p. 149.
[17] Schaefer, *op. cit.*, p. 230.
[18] *Ibid.*, p. 238.
[19] *Ibid.*, p. 236.

And Schaefer explicitly notes what is enervating in the uniqueness argument. Assuming the uniqueness position he draws the necessary conclusion when he writes:

> But there are no laws for the unique; little use, then, in looking for historical or geographical laws or prediction.[19]

Hartshorne introduces several pieces of evidence in support of the uniqueness position that must be answered. First, he states that geography is at a disadvantage because it is often faced with a limited number of cases.[20] The solution to this problem, though not easy, is to produce more general theory, hence more cases. Before Newton, no one realized that the falling of an apple and the movement of the moon were similar cases.

Hartshorne also argues:

> In studying the integration of phenomena in geography, even if limited to those of natural phenomena, we are concerned with highly complex situations which we must observe without means of control.[21]

As for complexity, occurrences always appear complex until order is discovered. Newton demonstrated this when he discovered order in celestial chaos. The lack of laboratory control, on the other hand, is a problem of experimental design. No laboratory experiment is completely controlled. The effect of uncontrolled factors is eliminated by randomization.[22] The greater the variance the larger the sample drawn, is a rule that applies in the laboratory and out. In the laboratory it is possible to lower the variance, thus decreasing the sample size. This, in turn, decreases the expense of experimentation. Therefore, the difference between laboratory and non-laboratory experimentation reduces to one of difference in expense.

Hartshorne goes on to tell, *a priori*, just where it is that prediction of human actions will fail, when he writes:

> The explanation of any problem in human geography by use of scientific principles will fall short of completion at the point where it is necessary to interpret the motivations and resultant decisions of particular persons.[23]

[20] Hartshorne, *op. cit.*, pp. 149—50.
[21] *Ibid.*, p. 151.
[22] Sir Ronald A. Fisher, "Mathematics of a Lady Tasting Tea," James R. Newman, ed., *The World of Mathematics* (New York: Simon & Schuster, 1956), Vol. 3, pp. 1512—21.
[23] Hartshorne, *op. cit.*, p. 156.

Many geographers bet their lives regularly that they can predict the decisions of particular persons when they step across a street in front of motorists held back by a red light. Powerful advances in individual and small group behavior by psychologists and sociologists refute Hartshorne's assertion.

Perhaps his most revealing statement reads:

> Thus, in order to explain fully by scientific laws of cause and effect a single decision of any single human being, we would need to know all the factors of his biological inheritance and all the influences which molded his character from infancy on — far more data than we could ever hope to secure.[24]

But science has long since stopped pretending that it can "explain fully". As stated before, it does not strive for complete accuracy but compromises its accuracy for generality. Any effort dedicated to *full explanations* must conclude with consideration of *unique events* since absolute accuracy would require a "generalization" of infinite, and therefore, impossible, detail.

Thus, Hartshorne's objections to generality in geography can be answered.

Symptomatically, throughout Schaefer's work runs the generic term *spatial* while Hartshorne uses the idiographic word *place*. The *space* versus *place* dispute is a direct consequence of their positions on general versus unique. Hartshorne is pessimistic as to our ability to produce geographic laws, especially regarding human behavior. Schaefer has done us a great service in sweeping away our excuses and thereby freeing us from self-defeat.

3. *The Impossibility of Compromise on the Issue of Uniqueness*

A single methodology cannot embrace both the unique and the general. In this regard it is instructive to consider Ackerman's attempt to reconcile the two positions. Ackerman endorses generality when he endorses theoretical geography. He writes:

> . . . analysis of the nature of two-dimensional distributions *in the abstract* should be able to furnish a theoretical framework with capacity to illuminate actually observed distributional patterns and space relations. Such a theoretical framework is probably as important at this time as definition of the earth's physical matrix for observation was at an earlier stage in the science. Geography thus far has been notably weak in its attention to this possible building block.[25]

[24] Hartshorne, *op. cit.*, p. 155.

But concomitantly, Ackerman clings to the notion of regionalism as the contemplation of the unique, and this leads him to a serious difficulty which he himself admits:

> It has been observed that geographers are not yet satisfied with the generalizations which they have produced. They have been beset with difficulties as they attempted to extend and refine their framework of concepts. These difficulties are greatest as the science reaches the culmination of its work, the analysis and description of the element-complexes which characterize areas on the real earth . . .
> . . . The methodological maze which confronts the student attempting to determine the nature of fundamental research in geography is all too evident. The development of generic concepts in the field has aided the comprehension of geographic reality, but the end product of geographic research still has been contemplation of the unique. Small wonder that the subject was open to characterization as an "art." The only ready way of integrating unlike entities has appeared to be through an intuitive process, and geography appears to be concerned with unlikes at a critical step.[26]

The solution to this difficulty of the incompatibility of the unique in regional geography and the general in theoretical geography is provided by Schaefer:

> . . . regional geography is like the laboratory in which the theoretical physicist's generalizations must stand the test of use and truth. It seems fair to say, then, in conclusion, that regional and systematic geography are codign, inseparable, and equally indispensable aspects of the field.[27]

In other words, if regional geography is associated with generic facts instead of unique facts and if systematic geography is associated with theoretical, Ackerman's difficulty evaporates, for the highly theoretical is not expected to approach the factual though they are inseparable and complementary. Only by the complete rejection of uniqueness can geography resolve its contradictions.

III. A SUGGESTED SCIENTIFIC METHODOLOGY FOR GEOGRAPHY

From the preceding sections of this chapter a scientific methodology for geography may be developed. The suggested methodology outlines

[25] Edward A. Ackerman, *Geography as a Fundamental Research Discipline*, University of Chicago, Department of Geography Research Paper No. 53 (1958), p. 28.

[26] *Ibid.*, pp. 15—16.

[27] Schaefer, *op. cit.*, p. 230.