In "Types of Synthesis and Their Criteria," Kenneth Strike and George Posner review fifteen types of knowledge synthesis, illustrating the close relationship of synthesis and research and the importance of defining the type of synthesis expected in a given project. They suggest that combining parts into a whole and conceptual innovation are the most distinctive features of a synthesis product. After indicating how the need for conceptual innovation places constraints on synthesis activites, the authors recommend that most synthesis work aim for moderate levels of innovation. Drawing implications for the practice of synthesis, Strike and Posner propose four criteria of a successful synthesis and discuss the purposes or uses of synthesis and the relationship of synthesis to two models of knowledge use.

Types of Synthesis and Their Criteria

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Imagine a researcher who has been asked to summarize and integrate the findings on some recent educational innovation. Let us supose it is a program in career education that uses the workplace to teach subjects normally taught in formal academic settings.

Suppose further that the findings to be integrated include some of the following:

1. Students who elected the program systematically reported they preferred it to school.
2. Parents of these students reported their children have a renewed interest in learning.
3. Students who elected the program had a history of absenteeism in school.
4. Students who elected the program were not significantly different from their peers in such properties as I.Q. or socioeconomic status.
5. Students who elected the program tended to value knowledge primarily as a means to economic advancement.
6. Students who elected the program scored about the same as their peers on basic skills tests.
7. Students who elected the program did less well than their peers on standard subject matter achievement tests.
8. Students who elected the program appeared more knowledgeable than their peers about some subjects which were not taught as part of the usual academic curriculum.

What might be done with such results? Consider some possibilities:

1. We might simply collect them and report them.
2. We might reorganize the findings under categories such as

"Reasons for Selecting the Program," "Student Characteristics," and "Effects on Learning."

3. We might note some generalizations within the various categories, such as "Students elect and enjoy the program to the degree they are economically motivated," or "Students in the program learn different things about subject matter, not less."
4. We might attempt to organize each of the findings and generalizations about the students in a more inclusive conceptual framework. For instance, the results noted above could be discussed in terms of alienation from learning.

These possibilities reflect two noteworthy properties. First, each step involves an increase in unity or integration of material. It is this increase which we believe characterizes synthesis. The first step, or stage, is hardly a synthesis at all. It is simply a collection or "assemblage" of information. By (4), we have succeeded in integrating what appeared to be quite diverse material into a single conceptual framework, which reveals each finding to be part of a theory of alienation. Here the conceptual integration is high.

Synthesis is usually held to be an activity or the product of activity where some set of parts is combined or integrated into a whole.[1] When synthesis is an intellectual activity, it requires combining intellectual parts into an intellectual whole. This is the process of integration.

This characterization of synthesis has the disadvantage of excessive breadth. Most intellectual activities involve some degree of integration or some move from part to whole. It is unclear what such a view of synthesis would exclude.

Synthesis has a second noteworthy property. It involves some degree of *conceptual innovation*, or the invention or employment of concepts not found in the characterization of the parts as means of creating the whole. A study which takes unrelated phenomena such as student absenteeism, student achievement, and student course preferences and defines them as aspects of student alienation would be high on conceptual innovation. It ties diverse descriptions of students together in an integrated framework by introducing a concept, alienation, found in none of them. By contrast, a simple generalization is low on conceptual innovation. If several schools report an increase in vandalism, a person who concludes that *all* schools are experiencing increased vandalism has brought specific instances together under a generalization, but has introduced no new concepts.

The relation between conceptual innovation and synthesis can

be defined as follows: *Among the class of intellectual activities or products where parts are combined into wholes, those cases which are higher in conceptual innovation are more central to synthesis than those which are low on conceptual innovation.*

This statement expresses two ideas. The first is that the notion of combining parts into a unified whole is essential to the concept of synthesis. Any intellectual activity which exhibits this property can be plausibly characterized as synthesis. Second, however, among cases of synthesis, activities or achievements which are high on conceptual innovation seem to be clearer cases. The discovery of a grand new scientific theory or the creation of a new philosophy which integrates diverse phenomena into a unified view seem to represent synthesis most clearly. It can be argued that generalizing over a few cases is also an act of synthesis, but not a paradigmatic case, nor an act central to the concept. The relevant difference seems to be the degree of conceptual innovation involved. Thus it is reasonable to say that synthesis is the act of unifying intellectual parts into a coherent intellectual whole, but that cases of synthesis involving a high degree of conceptual innovation lie at the center of the concept.

There are some intellectual activities which have much in common with synthesis. They involve imposing some form or order on information or ideas, but fall short of synthesis because they do not generate any unifying conceptual framework or integration of ideas. Scholarship often involves collecting and cataloguing information. Such acts impose order on ideas without integrating them. We will call these activities *quasi-syntheses,* since such acts perform some of the roles of synthesis.

Synthesis thus is not a simple topic. It is a multifaceted activity which needs to be described in its diversity. In this essay, we will address the following topics:

1. What kinds of intellectual activities and intellectual products can count as synthesis?
2. What kinds of criteria can be suggested for what will count as a successful and useful synthesis?

Before we address the first of these questions, a few caveats are in order. So far, we have indicated that synthesis is an inherently vague concept with boundaries that can be made sharp only in arbitrary ways. This suggests that in an attempt to describe types of synthesis, we cast a wide net. With this strategy, the concept of synthesis includes borderline intellectual activities and products which stretch the concept toward vacuity. This may frustrate the reader's desire for a sharp concept and clear cases of synthesis, but this strategy does reflect the structure of the concept. Also, it

will enable us to make potentially valuable points concerning noteworthy differences between different types of synthesis.

Some might respond that synthesis can be clearly distinguished from research. Research is the process which produces the knowledge to be synthesized. It is a direct investigation which produces the particular study or discovers the particular fact which is to be synthesized with other studies or facts. Research is, in this sense, a first order activity. Synthesis is a second order activity. It takes these parts produced by research and integrates them into some meaningful whole.

We grant the plausibility of this reaction, but also note that it substantially oversimplifies the relation between synthesis and research. Even the most empirical investigation will involve some synthesis in the realization of its results. It is almost impossible to separate the processes of investigation and the processes of understanding the results of investigation as this distinction between research and synthesis suggests. Research is structured by and described in terms of concepts and theories. Studies interact with a process of professional reflection and theoretical dialogue, which alters conceptions and produces new studies. It is not possible to sharply distinguish between the process of producing research and the process of reflection on research. Any attempt to make such a distinction sharp will distort the nature of rational inquiry.

Our view of synthesis reflects this notion. We see synthesis not just as an end step where the results of inquiry are digested, reported, and disseminated, but as a part of inquiry, intimately linked with its other aspects. The complex interrelationships among research and synthesis activities are seen in the following discussion.

Types of Synthesis

In this section, we wish to describe a number of intellectual enterprises which can arguably be counted as cases of synthesis. We make no claim that this list is exhaustive. The list is also epistemologically "pluralistic." The categories are not clear nor mutually exclusive. Where possible, we have grouped types of syntheses to exhibit their epistemological roots.

"Inductive" Syntheses

Here, synthesis is a process of generalizations which moves from concrete descriptions of a narrow range of phenomena to abstract formulations that govern wide and disparate ranges of phenomena. Various types of synthesis might be identified by describing phases or types of generalizations as follows:

Synthesis as Generalizing over Instances. Perhaps the simplest activity that can count as synthesis is generalizing over a number of cases. This transfer from the particular to the general is often referred to as *induction*. It consists of moving from a set of singular statements ("This five-year-old has a short attention span") to a universally quantified statement ("All five-year-olds have short attention spans"). In such a generalization, the substantive terms of the sentence ('five-year-olds,' 'attention spans') remain constant. What changes are the quantifying words. This kind of generalization can include scientific or causal laws. On this view, an inductive generalization would move from a set of singular claims that two variables or events are connected to the generalization that they are invariably connected.

Synthesis as Simple Theory Construction. Many philosophers of science have differentiated between theories and laws.[2] Laws are universal generalizations whose nonlogical vocabulary consists only of observation terms. (Observation terms refer to observable entities or events.) A theory is a statement or set of statements that explain a law and that contain theoretical terms (which refer to nonobservable entities or events). Simple theory construction is creating a theory that accounts for some law or set of laws. When a set of laws is explained by theoretical statements, those statements can be considered a synthesis of the relevant laws. For example, a statement such as "Water boils at 100° C" might count as a law. Statements designed to explain why water boils at 100° C and that contain terms such as *heat* and *molecular motion* would be part of a theoretical account of boiling. Kohlberg's theory of moral development and cognition theories of perception also represent examples of this sort of theory construction.[3] We have described this sort of activity as "simple" theory construction because there are a variety of activities that can count as theoretical. This sort may not be simple in the sense of easy, but its properties have been thoroughly described, and it has functioned as a standard case.

Synthesis as the Creation of Superordinate Theory. Occasionally in the history of science, intellectual achievements are found that successfully integrate and account for several lower order theories. Newton's laws of motion, which encompassed gravitation, planetary motion, and particle interaction under a common theory, is perhaps the best example. Such achievements not only explain lower order theories, but significantly reinterpret them. Kepler's view of his laws of planetary motion was substantially altered when the laws were seen as consequences of Newton's law of gravitation.[4] Indeed, Newton's work was the *coup de grace* for the "Medieval synthesis." It had implications for areas as remote as theology, ethics, and psychology. Many enlightenment philos-

ophers similarly saw the "mechanical view" as far more than a physical theory, but rather as the keystone to a new systematic intepretation of humanity and our place in the cosmos.

Synthesis as the Creation of a World View. Perhaps the ultimate in synthesis is the creation of a framework or point of view from which all other experience can be interpreted. Such a "world view" would likely transcend the bounds of science and involve religion or metaphysics. B.F. Skinner's attempts to apply behaviorism to issues of justice and ethics represents a familiar example.[5]

These first four senses of synthesis reflect some common epistemological assumptions. With the exception of the fourth, each assumes some version of the kind of empiricist perspective which has been common among Anglo-American philosophers for several centuries. These kinds of synthesis are the sort that will be readily comprehendible to the intellectual heirs of John Locke and David Hume.[6] To some extent, this is even true of the fourth. Certainly, empiricists from Hume to twentieth century logical positivists have cast considerable doubt on the possibililty of doing metaphysics. On the other hand, empiricism has had much of the flavor of a world view, generating not just views of knowledge and science, but of psychology, ethics, and politics as well.[7]

Dialectics

By contrast, several of the types of synthesis that follow will assume views of knowledge that are less clearly empiricist in character. This is particularly true of the next view, which originates with the logic of the German idealism of the previous century.[8]

Synthesis as Dialectical Resolution. In dialectical logic, a synthesis is regarded as the creation of a new conception, level of understanding, or state of affairs achieved by overcoming the tension between two conflicting or opposed ideas or states. The synthesis is the product of the resolution of conflict between a thesis and an antithesis. Contemporary readers will be most familiar with this idea in the Marxist interpretation of history. Educational readers will find many instances of dialectical reasoning in Dewey.[9]

"Kuhnian" Synthesis

The next several types of synthesis are expressed in the concepts of work done in recent history and philosophy of science during the last two decades. These sorts of ideas are most commonly identified with Thomas Kuhn's *Structure of Scientific Revolutions*.[10] A perfunctory sketch of the major points of Kuhn's work follows.[11]

Kuhn holds that most scientific work is dominated by what he terms a *paradigm*. A paradigm is some set of concepts or some achievement which sets the terms under which scientific inquiry will occur. A paradigm will indicate what counts as a problem, what counts as a solution to the problem, what counts as acceptable procedure for solving a problem, and what counts as proper concepts for discussing and describing the phenomena.

Accordingly, Kuhn claims that scientific work has two distinct phases. The first, which he terms *normal science*, involves extending or applying the paradigm to solve the range of puzzles or problems that the paradigm generates. Newton's laws of motion indicated the general assumptions under which planetary movements could be investigated. But there was much work to do regarding the details of orbits and investigation of discrepancies that arose. Of even more interest was extending Newton's laws to new areas, such as fluids or waves. Such work done under the assumption of some guiding concepts illustrates the phenomena of normal science.

Revolutionary science, by contrast, occurs when the paradigm itself is at issue. Revolutionary science usually occurs when a paradigm accumulates a set of problems or anomalies which it seems unable to solve in ways consistent with the paradigm's assumptions. The discipline enters a period of crisis, during which it must reorganize its basic assumptions. This process of replacing one paradigm with another is revolutionary science.

Synthesis as Normal Science. This, as described above, is the process of doing work in terms of a paradigm. It includes puzzle solving and the extension of the paradigm to new cases. Bringing a new phenomenon under the umbrella of an extant paradigm particularly seems to be a type of synthesis. For example, showing how declining test scores can be explained by an existing social theory would be a welcomed intellectual achievement that would count as normal science.

Synthesis as Revolutionary Science. This, as described above, is the process of changing the dominant assumptions under which a field does its work.

These two sorts of synthesis concern conceptual growth at the level of a field or a discipline. Analogous processes may be assumed to occur at the individual level. We might then distinguish between synthesis as employing some current conceptual framework to investigate or understand a new problem or area, and synthesis as the modification of dominant conceptual frameworks. Using the extant Piagetian terms, this would give us synthesis as assimilation and accommodation.

Synthesis as Overcoming Incommensurable Points of View. Different conceptual frameworks or paradigms provide conflicting ways to interpret and use various areas of experience. Such conflicts are not simple disputes about whether some commonly understood claim is true or false; they involve differing meanings of words and differing senses of what counts as problems and solutions. It becomes difficult for researchers to agree on the sense of the issue, much less a common answer. Following Kuhn, we describe this as conflicts between incommensurable points of view. Given that education and the social sciences generally are beset with disagreements and conflicting frameworks, we believe that overcoming such conflicts is a fundamental type of synthesis.

Synthesis as the Emergence of a Paradigm. One of the properties Kuhn ascribes to a paradigm is that it is the basis of any common understanding in a field. Advanced intellectual enterprises which have achieved a high degree of common understanding are held to have only a single paradigm at a time, except during a scientific revolution. Enterprises such as psychology or education, which lack a single unifying paradigm and are instead characterized by competing "paradigms," Kuhn describes as in a pre-paradigm stage. A final event which might count as synthesis within a Kuhnian point of view is the emergence of a single paradigm from a discipline with multiple "paradigms."

Interdisciplinary Synthesis

One of the most obvious areas for synthesis concerns the relations and interactions between various disciplines. Such interactions are sufficiently diverse that we will enumerate several subtypes.

Semantic Synthesis. Different disciplines often develop along parallel lines, but meaningful interaction is often frustrated by differences in vocabulary. For example, cognitive psychologists often appear to use *schema* the way philosophers use *concept* or *conceptual framework*. When disciplines use different words to talk about the same thing, it is also likely that they will have separate concerns and separate approaches to the phenomena. But when disciplines arrive at common points for different reasons and by different paths, they often have much to learn from one another. Creation of a common language can serve as the first step.

Synthesis as Generating Interdisciplines. Occasionally, theoretical developments in two or more disciplines converge in such a way that they begin to research the same or similar phenomena. Such occurrences sometimes result in the creation of new disciplines, which borrow concepts and methodologies from

their parent disciplines, but eventually develop their own unique conceptions and approaches. Computational linguistics (computer science and linguistics) is an example of this kind of development.

Synthesis as Generating Multidisciplinary Perspectives. Many decisions require that the input from other disciplines be considered and integrated into a cohesive view of the phenomenon. The issue of nuclear power requires the integration of ideas from disciplines such as physics, economics, ethics, geology, and ecology. Here generating a synthesis is not a matter of integrating the concepts of physics and economics. It is a matter of generating a point of view capable of considering and weighing data from diverse sources.

Quasi-Syntheses

There are a number of intellectual enterprises which involve constructive work with diverse sources of information, but which are not syntheses, because they do not or need not involve the creation of any integrating or unifying point of view. We will refer to these as quasi-syntheses. Here are some of the more interesting types.

Assessment. Some intellectual activites are like synthesis in that they involve judgments or conclusions based on diverse evidence. Such activities are not syntheses in that they involve choice, rather than integration. It will be useful to note two types of assessment.

Weighing the bulk of the evidence: One of the most common types of assessment is to sort through conflicting opinions on a subject and to select that view which seems best supported by the evidence. This type of assessment may be profitably contrasted with synthesis as overcoming incommensurable points of view. Incommensurability results from conflicting conceptual frameworks where even the character of the disagreement is at issue. Weighing the bulk of the evidence assumes an agreed-upon question, but incompatible answers. Assessment becomes a matter of determining which views the current state of evidence tends to support.

Judgment: Few real decisions are made only by a particular piece of research or a particular theory, no matter how well confirmed. Almost any decision in an educational institution will have consequences beyond those that are desired or anticipated. Actions will serve some values and frustrate others, and they will further the interests of some and not others. And every decision will raise questions of rights of participation or legitimate in-

terest. Thus, decisions cannot be justified simply by some research conclusion. The decision maker is usually called upon to balance competing values, interests, rights, and pressures. Such decisions require judgment, which refers to making choices where evidence is appropriate to the decision, but is not decisive.[12]

Application and Program Development. Another activity like synthesis is the development of applications of an existing idea. Theories are rarely self-applying. For example, it does not follow that if you accept the pedagogical principles of the structure-of-knowledge movement that you will know how to teach tenth grade geometry. Any theory which has an impact on educational practice has to be augmented with a variety of practices, procedures, and materials before practitioners will be able to enjoy it in the classroom. The generation or collection of such specific activities and material consistent with a theory is an important synthesis-like activity.

Assemblages. Syntheses involve the creation of some sort of intellectual product that is sufficiently integrated or cohesive to count as an intellectual whole. It is, however, possible to assemble ideas and information in useful ways that fall short of being an intellectual whole, and it is reasonable to assume that such "assemblages" will be frequent and important. Three types may be distinguished.

Eclectic assemblages: It seems reasonable that a set of ideas and advice can be assembled that provide functional guides to a range of practice, but where the set of ideas themselves have no theoretical unity.

Convergent assemblages: It is also possible for theories with concepts sharply at odds to converge with implications for a given range of practice. Such assemblages would show that a given practice is warranted by several theories which are otherwise inconsistent.

Policy convergent assemblages: A variant of convergent assemblages deserves special mention. People with conflicting interests or conflicting values may agree on a course of action if it can be shown to serve both sets of interests or values. In other words, arguments with incompatible premises may justify some common conclusions. This suggests that synthesis intended for policy purposes might marshal arguments from diverse points of view for a given policy or plan of action.

Criteria of Synthesis

What constitutes a good synthesis? We will divide this difficult question into two parts. The first will concern standards by which to judge the intellectual quality or soundness of a synthesis. The second part will concern the usefulness of a synthesis. In this section, we are concerned with the first question. While we recognize that these topics interact, treatment of the second topic requires development of some additional concepts, which we will undertake in subsequent sections.

We will begin with the possibility of doing various types of synthesis, and the problems that may result from premature or forced attempts at synthesis.

The types of synthesis and quasi-synthesis we have listed differ substantially in terms of their possibility. Some can be produced virtually at will; others are extraordinarily rare. More important, most require some substantive intellectual achievement. They are not just encyclopedias of current knowledge, but represent a creative and progressive transformation of current knowledge. Such syntheses have intellectual conditions. They can be done, but they cannot be forced. To demand them prematurely will produce confusion, not synthesis.

Several types of synthesis and quasi-synthesis are comparatively easy to produce. These types include generalizing over instances, weighing the bulk of the evidence, judgment, and the rest of the quasi-syntheses. Suggesting that they are easy to produce does not mean that they do not involve sophisticated or difficult processes, or techniques of measurement or assessment. The point is that they have few conceptual prerequisites. Their possibility does not require further substantive developments.

This is because they tend to require collection, summary, evaluation, and reaction to current research. But they do not require the creation of new concepts or the modification, transformation, reorganization, or application of current ones. Generalization requires only a change in the quantification words in a description of some phenomenon, not the addition of new descriptive concepts. We can also usually weigh the bulk of evidence for some claim without altering the concepts in which the claim is stated. The requirements for such activities are simply that there be instances to generalize over or evidence to assess.

Note that we are discussing the conditions for the possibility of synthesis. It does not follow that the results of such synthesis will be true or well warranted. A paucity of suitable instances to generalize over yields only tentative and uncertain generalizations. Weighing the bulk of the evidence may suggest we know

little. Synthesis is unlikely to exceed the limits of the research synthesized.

At the other extreme are syntheses that are extraordinarily difficult and where the conceptual preconditions are substantial. These types include the creation of superordinate theory, the creation of world view, dialectical resolution, revolutionary science, overcoming incommensurable points of view, and interdisciplinary synthesis.

These types of syntheses are difficult precisely because they require substantial conceptual innovations. They are more than collecting, summarizing, or evaluating current research. They involve creating new concepts and developing new conceptual frameworks. The creation of such new frameworks not only involves brilliance on the part of their creator, but is highly dependent on the availability of the right sort of ideas. Newton was not possible without Copernicus, Keplar, and Galileo. Such syntheses are extremely rare and cannot be ordered up by a federal agency or an act of Congress.

In considering criteria, we will be most concerned about those syntheses that represent a middle ground between these two extremes. Such syntheses require some conceptual innovation, but they do not require conceptual innovations that are out of reach except to persons of rare genius at just the right stage of a discipline's development. They may appear as routinely possible by persons of competence and perseverance. The danger is that people will attempt to produce the sorts of integrated conceptual systems which characterize a genuine synthesis by dubious means. The illusion of synthesis can easily be generated by the use of misleading analogies or metaphors. For example, Einstein's theories of relativity have commonly been used to argue ethical relativism. Yet Einstein's theories, rooted in the firmest of absolutism, can be extended to ethics only by a refusal to grasp the use of the word *relative* in Einstein's thought. The chief difficulty in attempts to synthesize ideas from different frames of reference is that synthesis will proceed from the confusion of the distinctive feature and ideas involved in the material synthesized, rather than from the substantive problems involved.

General Criteria

By what criteria might the intellectual quality of a synthesis be recognized? Here are some standards that would permit us to identify intellectual products that produce a higher degree of intellectual unity or cohesion in ways that are intellectually progressive.

A quality synthesis will clarify and resolve, rather than

obscure inconsistencies or tensions between material synthesized. Ideas from diverse sources need synthesizing because they are not initially consistent, commensurable, or do not clearly fit into a single framework. A synthesis which creates a common framework for initially diverse ideas should result in a clarification and resolution of the causes of such difficulties. It should not integrate material by obscuring the sense of the ideas, or by failing to note the distinctive role that particular concepts or ideas play in their initial conceptual frameworks. For example, we cannot synthesize differing views on the role of praise in learning by substituting the more neutral word *praise* for words such as *reinforcement* or *feedback*. This does not resolve the underlying conflict between behaviorist and cognitivist theories of motivation; it simply obscures them.

A quality synthesis will result in a progressive problem shift. Synthesis involves a conceptual innovation, as well as a reinterpretation of some of the ideas synthesized. Such a reinterpretation should be progressive and should increase our understanding of the materials synthesized. A progressive problem shift will exhibit such features as increased explanatory and predictive power and expanded empirical content, increased theoretical ability to explain ideas synthesized, expanded scope of application, and an increased capacity to identify and pursue unsolved problems.

A successful synthesis will satisfy the formal criteria for good theories. Such standards as consistency, parsimony, elegance, and fruitfulness characterize a good synthesis.

Standards for Useful Synthesis: Implications of the Model

What are the criteria which characterize a useful synthesis? We should first ask "useful for what?," since uses may be many, rather than one.

We would like to suggest that two contexts of use be looked at. First, what makes a synthesis useful to practitioners or decision makers, those who must do something or decide what is to be done? Second, what makes a synthesis useful to researchers? Our assumption in asking this second question is not that generating research is an end in itself, regardless of its potential use. Rather, we assume that maintaining a coherent research effort is in the long term interest of educational practice. (The usefulness of knowledge for practitioners is discussed further in chapters by Ward, Rich, and Nadler and Bozeman. Therefore, we will comment only briefly on that area.)

Concerning the needs of practitioners and decision makers, we might start with the suggestion that useful syntheses will be syn-

theses which answer the question asked. They should tell the practitioner or the decision maker what they believe they need to know in order to accomplish what they wish to accomplish.

This point of view has an asset and a liability. Its asset is that it indicates that useful knowledge results in recommendations that can be acted upon by the practitioner. Its liability is that it takes the objectives of the practitioners as given; it assumes the practitioner has an adequate understanding of the situation and has stated the problem and questions appropriately. Thus, taking the practitioner's objectives as given tends to limit implicitly the concept of the practical to the technical, and to ignore the importance of some form of theory in the practitioner's understanding and decision making. It also limits the role of the researcher and of research. Research becomes limited to concerns with how to do something, rather than with what is worth doing.

This includes taking stock of the current state and appropriate direction of a research program — to ask what we have learned so far, and where does it make sense to go now. How might we modify our hypotheses and plans of action so that our basic aspiration might be more adequately realized?

The second function of a synthesis is to ask whether the assumptions guiding the research program remain adequate. This is particularly appropriate when the research program seems to be faltering, when it is not progressing or is doing so in ways that are ad hoc or inconsistent. A research synthesis is an appropriate place to document the degeneration of a research program, to examine the adequacy of its assumptions, and to suggest how these assumptions might be modified or changed.

These suggest some general criteria for a synthesis that is to be useful to the research community. *A useful synthesis should do more than summarize the state of knowledge in an area. A useful synthesis will judge the state of health of a research enterprise and suggest future directions for it.* Some such syntheses will focus on the lower order assumptions and plans of action of a research enterprise. They will try to suggest new ways to implement basic assumptions. Others will investigate basic assumptions themselves and will suggest new fundamental assumptions to guide research. A synthesis that does neither of these should be of little interest to researchers.

These remarks may seem to suggest that syntheses for practitioners and syntheses for researchers should be fundamentally different — the former focusing on recommending actions, and the latter on furthering inquiry. No doubt there will be occasions

where it is reasonable to shift the emphasis of a synthesis, depending on the intended audience. However, we suggest that research can profit from using data from practitioners and from a higher degree of cooperation and a lessened division of labor between researchers and practitioners. At the very least, it is offensive to practitioners to be treated as mere recipients of the results of research, as though they were incapable of or had no need to understand the grounds for the actions recommended. These factors suggest that syntheses for researchers and syntheses for practitioners should not differ sharply.

Useful Syntheses and Models of Dissemination

We would like to conclude the discussion of the criteria and uses of syntheses with some general hypotheses about how different types of syntheses will interact either with different contexts in which they might be used or with different types of dissemination.

We have already suggested that one useful way to distinguish between syntheses is by the degree of conceptual innovation involved. Syntheses which require the collection, aggregation, and evaluation of research, but do not substantially involve a reconceiving of the assumptions under which the research was done, are low on conceptual innovation. Those syntheses that involve substantial changes of the assumptions which guide and structure research are high on conceptual innovation.

This distinction between high and low levels of conceptual innovation can be further defined by linking it to the idea of a research program. (The concept of a practical research program and other concepts pertinent to this discussion are discussed in detail in "An Epistemology of Practical Research," Kenneth A. Strike, Educational Researcher, Vol. 8 1, 1979, pp. 12-16.)That phase of inquiry which involves the development, implementation, assessment, and replacement of lower level hypotheses and plans of action can be considered low on conceptual innovation because the assumptions guiding research are assumed and are not at issue. The phase of inquiry that involves an assessment of the basic assumptions of research and leads to changes in its concepts is high on conceptual innovation.

One final set of ideas will be helpful to understand the contexts which govern the use of educational research. This concerns how research has an effect on practice. It will be useful to distinguish two broad models of dissemination that we call *The Pipeline Model* and *The Diffusion Model*. These should be regarded as ideal types, or as the poles on a continuum. We doubt that there are many pure cases.

The Pipeline Model

This model sees useful knowledge disseminated by direct contact between the knowledge producer and the knowledge consumer. The contact may be immediate, as when a particular user contracts for a particular piece of research to inform a particular kind of decision or practice. It may be less direct, as when knowledge is generated by a funding agent for a particular class of users. Typically, such knowledge is directed to a reasonably well specified question arising from some area of practice. Often its production will be consumer-generated. From the knowledge producer's side, knowledge will usually be targeted, if not to a known audience, at least to a known need or known question.

The Diffusion Model

The diffusion model sees the connection between the producer and user of knowledge as indirect. Such research is less likely to be done in response to some expressed need of practitioners, and it is more likely to be disseminated through research journals or through other media than through reports or periodicals targeted to specific user groups, and will often be done without any user or specific application in mind. When research does affect practice by diffusion, it will do so by paths such as altering a climate of opinion, affecting the views of legislators or their political agents, changing the character of research done, or changing the training of new practitioners.

These models are not models about what counts as useful knowledge as much as they are models about how useful knowledge gets used. We think it appropriate to note them because there may be some interaction between the kind of knowledge produced or the ways in which knowledge can be useful and the way in which it makes sense to disseminate knowledge. This suggests that there is a profitable line of inquiry that could be initiated to link types of knowledge with types of dissemination. This thesis has a negative corollary. There may be types of knowledge or ways in which knowledge can be useful to which a given type of dissemination is inappropriate. If this is the case, a fixation on one or the other of these models of dissemination may produce some undesirable consequences. We are particularly concerned with the possible consequences of an excessive emphasis on the pipeline model. To treat fairly direct contact between knowledge producer and knowledge consumer as the only, or the more legitimate, type of dissemination may narrow our concept of what counts as useful knowledge to that which immediately meets the expressed need of some educational practitioner. Knowledge which alters a climate of opinion or changes the direction of re-

search becomes suspect or illegitimate because it does not meet the expectations of the pipeline model, or its impact becomes blunted because it is not effectively disseminated.

We would like to conclude with one modest caveat. It may be that the phrase *high level of conceptual innovation* will seem a high status term and the phrase *low level of conceptual innovation* will sound almost derogatory. It is not our intention to establish a pecking order among these activities. Indeed, a case could be made for giving a preference to syntheses at a low level of conceptual innovation. After all, it is these which are likely to be of immediate use. Also, they have less formidable intellectual preconditions. In almost any healthy intellectual endeavor, most of the effort is spent in executing a research program, not debating it. A high level of preoccupation with fundamental assumptions is a sign that the research community collectively does not know what it is doing.

In education, perhaps a case could be made that we need to spend more time working on our fundamental assumptions. They are surely in doubt. But the would-be synthesizer should at least read the cautions in this paper which state that syntheses at a high level of innovation are unusual, difficult, and have preconditions. Attempts to force such syntheses may proliferate confusion rather than wisdom.