Systems Research Vol. 5, No. 1, pp. 9–25, 1988.
Printed in Great Britain.

0731-7239/88 $3.00+0.00
Pergamon Press plc

A Total Framework for Inquiry

WARREN KINSTON

Sigma Centre, Institute of Organization and Social Studies, Brunel University, Uxbridge, Middlesex UB8 3PH, U.K.

(*Received* 29 *June* 1987; *in revised form* 30 *September* 1987)

Key Words—Inquiry; inquiring systems; knowledge; representation; testing; hierarchy; epistemology; philosophy; creativity; imagination.

Abstract—The *total framework for inquiry* is formulated as consisting of seven hierarchical levels. The lower five, as described previously (*Syst. Res.* 2 (1985), 95–104), are concerned with representing knowledge; the sixth level has the function of testing and contains 'inquiring systems'; and the seventh level contains the function of wonder. The *inquiring systems* are an image of the framework and therefore also form a seven-level hierarchy, in which the lower five levels have been identified previously by Churchman (*The Design of Inquiring Systems*, Basic Books, New York, 1971). Two further inquiring systems are described: the sixth is the 'dialogic' and the seventh is the 'contemplative'. The *core testing processes* which underlie each of the seven inquiring systems and provide each with its different guarantee of truth are distinguished. Each core testing process (and hence each inquiring system) is shown to be underpinned by a particular level in the inquiry framework. Various symmetries and the possibility of homology between the two hierarchical structures are briefly explored.

INTRODUCTION

INQUIRY is the process of producing or obtaining knowledge by representing the world. As the process affects the form of the representation, any representation of the world should include an indication of how that knowledge was obtained. A practical consequence is the requirement that scientific papers include information about the methods used. However, the injunction also has a theoretical consequence: it implies that any formal attempt to model the process of representation should include all elements in the inquiry process.

In a previous contribution to *Systems Research* [23], I offered a five-level hierarchical framework of distinct representing activities to explain and describe scientific analysis and knowledge production. Scientific analysis and representation is itself inquiry, and the levels of representation may therefore also be seen as levels of inquiry. However, while the system was complete in so far as *knowledge production* was concerned, it did not include the whole of *inquiry*. I indicated then that certain elements associated with the inquiry process, such as hypothesis testing, must lie in a higher domain [23, p. 100] but I was not able to elaborate this conviction with precision. This is now possible, and the purpose of the present paper is to formulate the higher domain.

The paper will argue on the basis of empirical and theoretical investigation that the higher domain contains two further hierarchically-ordered levels of inquiry which complete the framework of inquiry utterly. The concrete practice of knowledge-creation is defined by the set of five levels, as originally proposed, plus two higher levels which serve to guide and structure inquiry. These higher levels are purely theoretical approaches which cannot be operated other than by use of the mind. Churchman's five inquiring systems, as described in *The Design of Inquiring Systems* [8], are situated in the lower of these two higher levels. He implied that the inquiring systems might be seen as evolving from a primitive to an advanced form [8, p. viii]; and I have suggested elsewhere that the evolution might be in the form of hierarchical emergence [21]. If this secondary hierarchy of inquiring systems were symmetrical or homologous to the primary hierarchy of representation/inquiry itself, then two further inquiring systems are implied with a hierarchical relationship to those already identified. The present paper supports the case for homology. It will do so by empirically identifying and describing two additional inquiring systems which emerge to complete the secondary hierarchy; and by theoretically demonstrating how the inquiring systems themselves link reflexively to the primary framework of inquiry.

LOWER LEVELS IN THE *FRAMEWORK OF INQUIRY*

In the earlier paper [23], I analyzed the levels of inquiry and representation from the point of view of ordinary human purposes to be achieved by the inquiring or representing activity. The emphasis was placed on representation because that paper focussed on the misuse and misunderstanding of measurement in the social sciences. Here, the emphasis will be on inquiry. A brief resume of the first five levels in the framework of inquiry as described in the earlier paper is necessary before proceeding further.

The principles on which the hierarchical ordering of inquiry/representation are based are as follows. Each level can be built from the one below by addition of a fundamental concept. Each level has its own fundamental concept, its own purpose, its own puzzle to solve, its own operational and mathematico-logical activity, and its own experiential location. The uncertainty of inquiry varies from level to level in association with characteristic inherent and unavoidable types of error. Table 1 summarizes the main points under these headings and the following brief description should be read in conjunction with it.

The contents of the representational part of the hierarchy are as follows. Level I inquiring is *conceptualizing*. Concepts (entities or ideas) are the vehicle which permit and are a result of this process which is essentially that of identifying or making distinctions. Conceptualizing serves to reduce confusion. Level II inquiring is *observing*. Facts are the vehicle formed by indicating or pointing to something, hence they depend on the additional idea of thingness. Examples of a concept can now be observed and referred to directly. Level III inquiring is *comparing*. Comparisons require the further idea of value so that things can be ranked or ordered. Level IV inquiring is *measuring*. Measurement adds the notion of a standard unit, and allows for precise, generally applicable comparisons or valuations. Finally, at Level V, inquiring is *relating* or formulating. The system is here completed reflexively by connecting or relating products of any level of inquiry, including Level V itself. Relating is therefore the new idea and its vehicles include matrices and formulas. Relations are experienced as usable knowledge and are the basis and spur for action. The experiential location of the representing (inquiring) activity oscillates between internal or subjective and external or objective. Thus making distinctions (I) is felt to be subjective. Observing (II) makes distinctions objective and publicly sharable because it is based on external reference. Attributing value (III) is held to be subjective. Measuring

Table 1. Levels and their characteristics in the basic 'framework of inquiry'

Level	Practical activity	Vehicle (label used in [23])	Experiential location	Purpose	Puzzle	Inherent error	Degree of uncertainty
I	Conceptualizing (recognizing, distinguishing or identifying)	Concept or idea (entity)	Subjective	Reducing confusion	Does it exist?	Making the wrong distinction	High uncertainty
II	Observing (indicating, referring or pointing to)	Fact or thing (observable)	Objective	Making public what was private	Is that it?	Misclassification	Some uncertainty
III	Comparing (ranking, ordering or valuing)	Comparison (comparable)	Subjective	Apportioning value	Which is more?	Systematic bias	Minimum uncertainty
IV	Measuring (i.e. comparing using a standard unit)	Measurement (measurable)	Objective	General application	How much is it?	Random error	Some uncertainty
V	Relating (connecting or formulating)	Relation (relatable)	Subjective	Basis for action	How does it fit in? What is it about?	Missing the main point	High uncertainty
VI	Testing (substantiating or guaranteeing)	Inquiring system	Objective	Maximizing certainty	Is it true? How is it guaranteed?	Limitations of the inquiring system	Maximum possible certainty
VII	Wondering (speculating or conjecturing)	Imagination	Subjective	Meeting the need to know	What needs to be known? And how?	Asking the wrong question	Absolute uncertainty

(IV), which makes comparisons precise by using an agreed external standard unit, is publicly sharable and objective. Relations (V) require plausibility and are formed subjectively.

HIGHER LEVELS IN THE *FRAMEWORK OF INQUIRY*

As indicated above, the five-level system is closed in on itself and therefore complete in so far as it describes all possible practical or concrete operations of inquiry in the real world. However the model does not comprise within it all that is required to produce knowledge. Clearly the levels do not give any indication about what is to be investigated or how knowledge is to be gained. Here there are real choices to be made. Which problem is likely to be soluble? Are facts to be collected, or is a simulation to be developed? Should current knowledge—concepts, facts, comparisons, measurements, relations—be accepted? Above all, how is the irreducible uncertainty to be overcome—by analysis, by experiment, by some other method—so that confidence in results can be gained? These choices define the inquiry process further, but now holistically. In other words, there must be a domain of higher levels which treat the lower five levels as a complete system for knowledge production. Like the lower levels, the higher levels of inquiry must be exoteric, that is to say, used spontaneously by the man in the street. Ramifications within the higher levels will, however, be esoteric, because the scientist or professional inquirer, who needs to use all levels systematically and explicitly, must understand their properties and significance in some detail.

If the higher levels are indeed part of the same framework as the lower five levels, then it should be possible to describe inquiry at these higher levels in the same terms as the lower levels. Hence Table 1 is based on a matrix from the original paper, but with certain columns omitted. The column of fundamental entities is not required because the higher levels are themselves real world products and therefore consist of relations. Columns for numbers and mathematical operators also illustrated distinctions amongst levels I–V. However, these symbols are only applicable to the *actuality* of representing (and the associated issue of scaling) and are therefore not primary attributions of the higher levels. The two higher levels will now be described in detail.

Level VI *inquiry: testing, or using 'inquiring systems'*

Scientists and philosophers of science have been concerned to develop detailed methods of inquiry to suit their particular problems, and also to articulate epistemologies to justify these activities and guarantee that the results may be accepted with some degree of confidence. Taken together these methods and epistemology constitute a test of knowledge. In other words, the essence of the practical activity here is testing. Testing is a complex process that, when analyzed in real world inquiring, appears as the use of an *inquiring system*, to adopt Churchman's term [8]. The vehicles for testing are distinguished from vehicles at lower levels by being, even in their simplest form, discrete and complex systems. At the core of each of these systems is a distinct approach to testing.

An inquiring system (Level VI) tells the scientist how he is to approach the real world, what lower levels are particularly important, and how the products at each level are to be seen in relation to each other. There are a number of discrete inquiring systems. It is possible to live, work and die completely identified with one of them and to denigrate and devalue the activities based on others, sincerely believing them to be invalid or inferior in absolute terms. Churchman's brilliant analysis of inquiring systems [8] was based on the work of his teacher, Singer [52], and has been articulated further by his pupil, Mitroff [38, 39].

Unlike many modern philosophers of science, Churchman never lost sight of the notion that scientific endeavour was imbued with purpose. He regarded science as inextricably part of the reality of the social system within which it wished to investigate; he believed that scientists needed to be self-aware; and he was able to appreciate assumptions underlying all varieties of useful inquiry. *However inquiry to assist human and social action is not identical with, and therefore cannot fully replace, inquiry whose sole purpose is the production of generalized representations that are likely to be true* [cf. 55, pp. 134–135]. To put this another way: to conduct an inquiry into the nature of an aspect of reality is a different task from presenting information on the nature of a problem to a decision-maker—and this point is not made sufficiently clear by Churchman [cf. 39, p. 221].*

The completion of the Level VI row in the matrix of Table 1 allows comparison of properties of an inquiring system with properties of lower levels of inquiry. Testing is the dominant activity at this level: a test meaning 'that by which the existence, quality or genuineness of anything is or may be

* Apparently Churchman does not accept the distinction. He writes: 'I don't accept the idea of knowledge for its own sake' (personal communication, 1987). The view taken in this paper is that inquiry for its own sake as taught universally to scientists is not only real and valid, but is a wonderful expression of the human spirit.

determined' (OED). The etymology of test is Latin: *testa* meaning a pot. In other words the inquiring system *contains* reality for us, because systematic inquiring simultaneously tests representations out as it produces them.

As clarified by Warfield [54], the practice of scientific inquiry involves systematically constructing an inquiring process using two basic activities: analysing or partitioning [π] and synthesising or integrating [Σ]. The purpose of inquiring systems is to maximize certainty in this work. Indeed in the alternation between the sense of subjectivity and objectivity, noted at lower levels, this level is objective. The puzzle which is uniquely handled at this level is: Is it really true?—'it' referring to the entity, observation, comparison, measurement, or relation under consideration. Even the inquiring system itself needs to be reflexively tested. The typical error which therefore emerges at this level is due to the basis of testing, that is to say the inquiring system chosen, having inherent limitations (*v.* Table 2, columns 7 and 8). At the extreme, an inquiring system may be inappropriately applied.

Given that each inquiring system limits sight of certain aspects of the total situation, and given that there is a self-multiplying degree of uncertainty inherent in making numerous distinctions (I) and relations (V), it follows logically that all inquiry must be associated with an extremely high degree of uncertainty. Nevertheless the function of testing is to produce the maximum possible certainty. It does so most overtly by using the function of criticism, which is a probing inquiry into the inquiry. Proper use of critical questioning within agreed bounds defined by the inquiring system in use *creates the sense that knowledge has actually been generated, irrespective of the inherent uncertainties.* As a consequence, firm adherents of particular inquiring systems usually minimize the extent or intensity of uncertainty, and avoid recognizing the partiality of their view. A less satisfactory tendency is the common urge to critique products of other inquiring systems by appeal to wholly inappropriate criteria which violate the assumptions of the inquiring process actually used.

Churchman attempted to rescue the scientific endeavour from being overwhelmed by irreducible uncertainty by concluding that 'faith is an integral part of all inquiry' [8. p. 243]. Polanyi similarly worked to establish as appropriate man's 'power for the deliberate holding of unproven beliefs' [47, p. 268]. Without an awareness of the role of faith and belief in underpinning scientific method, dogmatic defence of the scientist's own inquiring system combined with annihilatory hostility and devastating condemnation of alternative inquiring systems is only too likely to continue [21, 39]. Any complete model of inquiring must explicitly account for both doubt and faith in inquiry, so this issue will be returned to.

Level VII *inquiry: wondering*

If we take the approach and attitude we have adopted thus far to its ultimate, it is clear that another level is required, and that this level must be the final level of inquiry within the framework of inquiry. There is still a further question, a further activity, a further purpose and puzzle which are inherent in any inquiry when this is regarded as carried out by real people in a real social environment. This new task is *creating the object of inquiry.* Without creating some focus of attention, no detailed inquiry process could be initiated, no hypothesis could be developed, and no knowledge would be created. As predicted by the schema, this activity is experienced as profoundly subjective: presumably it touches on 'the essence of the creative in each one of us' [8, p. 205].

The individual, much as when engaged in Level I activity [23], is surrounded by a world that is partly given and partly undifferentiated and non-represented. This total environment is an unbounded and undefinable system. It is entered by the practical activity of *wondering*, whose purpose is a realization of the need to know. For those who are by nature curious, the need to know is a hunger, a drive, a quest, which can never be fully satisfied. For the man in the street, the need to know may be strictly practical. It feels almost identical with the need to do; but the doing is based on assumptions (knowledge) of the relevant world of the activity. When doing does not achieve the desired objectives, or it is not clear what exactly should be done to further desires and purposes, then even the man in the street wonders exactly what is going on, what possibilities might exist, and how he might get the required knowledge to progress. Desires and purposes are therefore essential orienting components of wondering, distinguishing it from imaginative reverie by providing a specific practical and personal focus. Wonder (VII) is hierarchically above constructing an inquiry (VI) because, for the inquirer, it is also necessary to wonder about the inquiry process itself, which inquiring system to choose or, more usually, how to implement it.

The puzzle that emerges at this level is 'What do we need to know?'—which, because science is the art of the soluble [37], is followed rapidly by 'How can we know it?'. Inherent error does exist at this level because it is possible to ask the wrong question—Mitroff and Betz's 'error of the third kind' [40]—and in any case there are always other things we need to know and other ways we might satisfy our curiosity. The effective operation of wonder

distinguishes the creative research process, which applies methods, however apparently routine, in a fresh innovative way, and tackles its subject in a similar fashion. The routinized research process excludes wonder: its topics are investigated without imagination, and its methods are chosen imitatively or from habit. This analysis suggests that imaginative techniques should be generally fostered in scientific training. They are relevant to all forms of inquiry and complement any preferred inquiring system, or any systematic approach to inventive activity such as that suggested by Altshuller [1].

It seems appropriate to specify the degree of uncertainty at this level as 'absolute uncertainty'. This may be the basis of the high value placed on doubt and scepticism in scientific practice. After presenting results in a scientific paper, it is an important custom to offer alternative explanations, first in terms of uncertainties due to inherent lower level error, and second by devising imaginative but plausible alternative scenarios. Scepticism, properly applied in this way, encourages wonder by asking new questions and diminishing rigidity of outlook.

The framework of inquiry as a whole

Each of the levels of the framework of inquiry might be properly termed inquiry. All levels need to be driven by and infused with the spirit of wonder (VII). However, only at Level V, where actual relations are explicit, does inquiry produce usable knowledge; and only at level VI does inquiry check the truth value of knowledge. Selection of a scientific hypothesis and then a research design are therefore born between or through conjunction of Level VII and Level VI inquiry and should occur in a state of intense uncertainty. How the world is defined and represented so that an inquiry process can be carried out and knowledge result from wonder is then a matter for inquiry at Levels I–V.

Making distinctions (I), like wondering (VII), is purely mind-based. Wondering (VII) about concepts (I) that are already part of existing knowledge will destabilize them. In a single mental act the whole painfully and effortfully constructed edifice of knowledge can be reduced to the meaningless chaos out of which it arose. The lowest (I) and highest (VII) levels therefore curiously link up with each other, both searching the not-yet-articulated-universe to commence or to recommence representational activity. This not-yet-articulated-universe, this not-even-chaos, this undescribable void, which is both Level '0' and Level 'VIII', was described earlier as the environment or context of the framework of inquiry. Knowledge may emerge from it and may disappear back into it, that aspect of the world becoming for the moment unrecognizable or indistinguishable, and therefore non-existent.

Given this environment of 'non-existent unknowledge', man has striven to find ways of developing confidence in what knowledge he has, and of ensuring that any knowledge produced is adequately substantiated. However, as noted earlier, agreement amongst inquirers on what makes for confidence or constitutes adequate substantiation is noticeable by its absence.

HIGHER LEVELS IN THE *HIERARCHY OF INQUIRING SYSTEMS*

We therefore turn now from *levels of inquiry* to *levels of inquiring system*—the latter, as has been argued, nested within level VI in the former. To distinguish between levels of inquiry and levels of inquiring system, the latter levels will be indicated with a prime. Churchman has described five varieties of inquiring system as follows:* I′—formal or deductive, II′—empirical or inductive, III′—synthetic, explanatory, or representational, IV′—dialectic or conflictual, and V′—holistic or interdisciplinary. It must be emphasized that Churchman and Mitroff both prefer to present these systems as a simple set or list. It will be shown through analysis of basic assumptions in the final part of the paper that inquiring systems are appropriately represented as hierarchically ordered. and they will therefore be referred to in this way.

Except for Level V′, the holistic inquiring system, the levels have been well elaborated in the literature of various disciplines and domains. So instead of a text summary, the reader is referred to a set of precise formulations in Table 2 which provides a description of each system when used in a real-world situation. The formulations differ somewhat from previous accounts by Churchman and Mitroff, in that they have been developed on the basis that each level has its own language and so leads to a distinct view of the world. Key terms, such as 'model' and 'fact', are level-specific and using them loosely as if they were generally applicable and meaningful in all inquiring systems confuses systematic inquiry in this area. Previous formulations have also been unsatisfactory insofar as they have embedded aspects of the decision-making process within the inquiring process [39]. Church-

* Churchman associated each inquiring system imaginatively with a modern philosopher, in order: Leibniz, Locke, Kant, Hegel and Singer. However, because some of Churchman's ideas about these philosophers are idiosyncratic, their introduction serves as an irrelevant source of criticism, and tends to obstruct the main task of elucidating the framework of inquiry. The philosopher labels have therefore been completely omitted in this paper and the labels used follow Mitroff with some modification.

Table 2. Principle characteristics of the hierarchy of practical inquiring systems as used within a situation to aid a decision-maker

Level	Nature (labels) Col. 1	Result of an inquiry (example from health services research) Col. 2	Growth of knowledge in the situation Col. 3	Relation between realities and representations (cf. core testing processes) Col. 4
I′	Formal (analytic, deductive, rationalist)	A value-free analysis pertinent to the situation, e.g. analysis of the different types of health care programmes.	Generating ever more elaborate and grounded analyses.	Representations, deriving from elementary formal reasoning, reveal and embody enduring self-evident properties of the situation. Realities are complex and difficult to know. cf. mathematico-logical reasoning.
II′	Empirical (inductive)	Empirical content on its own pertinent to the situation, e.g. and epidemiological survey of morbidity.	Amassing and organizing ever more facts.	Representations are justified by the facts (i.e. realities) deriving from sensory experience. Ideas and reasoning are subjective and hence untrustworthy. cf. empirical investigation.
III′	Synthetic (representational, explanatory)	Selection of a better alternative in the situation, e.g. randomized controlled trials of alternative regimens of care.	Trying out and progressively improving ever more detailed alternatives.	Representations and realities are inseparable, each deriving from and interacting with the other. So multiple representations of the same reality need to be developed and compared. cf. hypothesis testing.
IV′	Dialectical (conflictual, critical)	Exposure of conflicts in the situation due to opposing assumptions, with or without a resolution, e.g. critical analysis of a health policy decision.	Devising ever more powerful syntheses and recognizing ever more antinomies.	Complete representations must contain at least two directly opposite representations and agreed realities can support either. Representations are imbued with value and affect agreement on reality. cf. dialectic analysis.
V′	Holistic (interdisciplinary, 'soft-system', developmental)	Formulation of a model to indicate actions to change the whole situation, e.g. developing a model for practical organizational change.	Developing ever more extensive and finely-tuned models.	Representations are used to alter realities in line with intentions. Representations require key factors in reality to be interrelated to form a structured system. cf. system modelling.
VI′	Dialogic (philosophical)	A conceptual analysis of aspects of the situation divorced from immediate action, e.g. understanding the meaning of dying.	Producing ever more sophisticated arguments and conclusions.	Representations depend on a properly used framework of relevant fundamental terms provided by ratiocination and discourse. Realities are taken for granted, are not relevant or are challenged directly. cf. philosophical analysis.
VII′	Contemplative (imaginative, speculative, intuitive)	A whole formulation which completely grasps the situation and its resolution. (No specific example—can apply to many topics at each level.)	Creating ever more imaginative possibilities at all levels.	No distinction exists between realities and representations. Representation stems from truth immanent in the mind which employs image, symbols and the logic of the unconscious. cf. imaginative insight.

Table 2. (contd)

Certainty of output Col. 5	Indications for use Col. 6	Dangers (usual criticisms) Col. 7	Contraindications for use Col. 8
Very uncertain, as analysis may be inapplicable or artificial in the actual situation.	• Well-understood and well-defined topic with clear objectives. • Inquirer understands the topic and how it relates to the situation.	• Proliferation of propositions with little concern for data or implementation. • Analysis becomes a self-fulfilling prophecy (i.e. 'true by definition').	• Situation is poorly understood. • Inquirer does not understand the issue in context. • Analysis is over-extended or over-elaborate.
Uncertain because experience is fallible, and facts get very complicated on close inspection.	• Well-structured recognized problem. • Agreement about relevant objectives. • Simple experiment or data collection will suffice. • Inquirer has a 'feel' for data.	• Proliferation of data with little concern for explanations or subjectivity (e.g. goals, attitudes). • Excessive reliance on agreement. • Loss of extreme possibilities.	• Ill-structured problem is made to look well-structured. • Hard data is limited, too costly to obtain, or inaccessible. • Consensus on data is lacking.
Maximum certainty because many perspectives and possibilities can be examined.	• Ill-structured problem but an overall picture is available and a part can be defined and focussed on. • Objectives are clearly given. • Inquirer takes a balanced and unbiased view.	• Proliferation of alternatives. • Important alternatives are omitted, or trivial ones are included. • Realities and representations are changed to carry out the test. • Too ready acceptance of the validity of controls and indicators.	• Overall picture is unavailable. • Objectives are confused. • Inquirer is biased.
Uncertainty which may lead to vacillation between alternatives or to polarization.	• Ill-structured topic whose true nature is in doubt and subject to intense debate by experts. • Opposing objectives in the situation. • Inquirer capable of intuitive and synthetic reasoning.	• Proliferation of unnecessary conflict. • Loss of contact with specific realities. • Excessive influence of prejudice. • Development of weak compromises.	• An optimal solution is available. • Issue is well-structured and uncontentious.
High uncertainty as the situation is ever-developing and psycho-social aspects of participants and inquirer must be included.	• Situation demanding explicit structuring so as to aid intervention. • Concern for future development. • Objectives unclear. • Use of personal power likely. • Inquirer can reason reflectively.	• Generation of unnecessary complexity, uncertainty and individual awareness to violation of values. • Lack of concern for reliability, validity, consistency, objective certainty, or conflict and power issues.	• Simple alternatives must be decided. • Sense of certainty of results or acceptability to participants are of over-riding importance.
Absolute uncertainty; source of doubt and dogmatic belief.	• A framework for thinking is required. • Difficulty with problem formulation. • Issues of self-description or identity are present. • Inquirer capable of sustained theorizing and arguing.	• Degenerates into sterile word-play. • Degenerates into fanaticism. • Lack of a basic understanding of the topic in practical terms.	• Practical inquiry at lower levels is needed urgently.
Absolute certainty: source of faith and inspired belief.	• Existing paradigm or idea has too many obvious anomalies; or too many philosophical objections • Inquirer capable of concentrated contemplation and abandonment of previously held convictions.	• Development of an idee fixe, or messianism; which may lead to the insight being applied outside its area of development. • Nothing but speculation. • Motivated by a desire for glory.	• Much immediately useful can be done within the existing paradigm. • Social recognition of the need for imaginative reformation is missing.

man's intense and confusing desire to sweep in ethics and aesthetics and include the concept of progress within inquiring at Level V' is one unsatisfactory consequence of this conflation. Such important considerations are more naturally seen in the context of choice and the design of action. The position taken in this paper—and worked out in more detail elsewhere [25]—is that inquiring and action are conceptually and practically distinguishable.

Table 2 therefore indicates for each inquiring system in its own language: the typical output with an example from health services research; the way knowledge of a situation grows; root testing assumptions embodied in the relation between representations of reality and actual realities; certainty of the output; indications and contra-indications for use; and possible dangers or common criticisms. More detailed examples of research work at each level have been provided elsewhere [21, 22, 39].

The framework of inquiring systems can be clarified and developed by explicitly recognizing *core testing processes* which underlie the various sorts of inquiring system. This core becomes most evident when inquiring is divorced from the needs of social action and carried out solely in order to represent. This is because core testing processes are to do with the certainty-conferring function of inquiring systems. The basic idea here is that explicit inquiring systems have evolved historically and unself-consciously out of more direct and primitive processes of practical inquiry and action. And in turn core testing processes have developed historically from (self-)conscious efforts to purify the essence of testing. Eventually, and relatively late in man's development, testing and the production of generatlizations became an activity for its own sake. Core testing processes will be examined further in the final part of the paper. The relationship of the inquiring systems and their core testing processes to the framework of inquiry is shown in Fig. 1.

Although scrutiny of the research literature in a variety of disciplines does tend to suggest that the hierarchy is complete, both Churchman and Mitroff positively disclaim that the five systems are exhaustive—'such a claim would be as absurd as it would be pretentious' [39, p. 221]. It is necessary to consider whether someone 'wondering' about something might choose to know about his object of interest in some other way, a way perhaps beyond usual or direct scientific work. Although Churchman seemingly knew this and talked extensively around the issues, he deliberately avoided providing a clear answer, apparently on the basis of his belief that some things are best left untouched and unformulated. The present author holds that explicit description and discussion is closer to the spirit of science.

If, as suspected, the hierarchy of inquiring systems is symmetrical with the hierarchy of inquiry itself, then seven systems should exist. The present five systems are systems of actual inquiring akin to the lower five levels of inquiry which generate actual knowledge, hence two further higher level inquiring systems are to be expected. Wondering about inquiry with this in mind has revealed the existence of two further approaches which deserve to be labelled inquiring systems. These additional systems for developing and testing knowledge are the intellectual foundation of the birth of rationalism and modern science in the 17th century. Despite possessing the essential qualities of inquiring systems, they feel different from the inquiring systems already referred to because they are not modes of concrete investigation of the world. The higher levels can be characterized under the same headings used to describe the lower levels, as shown in Table 2.

Level VI' *inquiring system: the dialogic*

All lower level inquiry systems are in their very nature comprised of words or mathematical symbols linked into propositions, and they operate with assumptions as to the meaning of these. It is therefore necessary to develop an inquiring system which can regard this symbolic–linguistic structure as the focus of a critical inquiry effort—and this is to move one level up the hierarchy to VI'. Such a move takes the inquirer away from an immediate focus on a particular concrete part of the real world, and the inquiry is therefore usually labelled philosophical rather than scientific. Be that as it may, it is another inquiring system, and it is implied by lower levels and itself implies lower levels. The underlying assumption of this system is that all inquiry depends on the correct use of key ideas combined with reasonable arguments based on assumptions acceptable to the human mind. According to VI' inquiring, certainty depends on the structure within which findings are obtained and presented (the inquiring system), because concrete evidence as to reality and any representations of reality are derived from these assumptions and subordinate to them. Certainty also depends on the fundamental terms in which the evidence is couched and these stem from deep assumptions within the topic under study. Knowledge in the topic area is therefore developed by ratiocinative analyses of terms, arguments and assumptions within that arena. The results of such inquiry are conceptual analyses divorced from action but nevertheless of relevance to it.

Because terms and arguments only exist in the process of dialogue, this inquiring system may be termed the 'dialogic'. The arch-protagonist of the careful examination of terms and assumptions was Socrates. As demonstrated in Plato's dialogues, conviction can be developed through dialogue or through witnessing a dialogue. The dialogic quality of ratiocination is reflected in the common formation of small seminar groups of scientists or practitioners with a philosophical bent who feel a real need to examine what underpins their work. Churchman's book emerged from such seminars.

The dialogic method applies, of course, to the most general and perennial human concerns such as existing, knowing, relating, feeling, communicating and valuing. Such inquiry, though driven only indirectly by intelligent action, may have practical consequences. Longstanding areas of philosophical inquiry of a more directly practical kind include politics, education and law; but these are still largely in the realm of professional philosophers. At the most immediate applied level is dialogic inquiry driven by the everyday needs of practical inquiry and action. Such knowledge is produced by scientists with a capacity for philosophizing or by philosophers prepared to identify themselves with a practical activity. It is a sign of scientific health and societal maturity that studies and journals of applied philosophy are slowly emerging in new areas as disparate as biology [51], artificial intelligence [10] and social work [32].

In other words, although the Level VI′ output is deliberately divorced from action, it may influence actual research and development of practical knowledge in due course. Because clarity as to the possible meanings of key terms and value implications of assumptions are divorced at this level from any committment to action, a more radical form of critical inquiry is possible without time pressure linked to practicalities of change. For example, in health services, the philosophy of medicine stands above but can inform and in due course lead medical practice [45]; and debate over the meaning of each term in the phrase, 'managing dying patients', can be expected eventually to affect actual care regimens. The resource requirement for Level VI′ inquiry, therefore, is that the inquirer and his small group be capable of sustained creative but rigorous theorizing and arguing without responsibility for action.

Testing by ratiocination may be called scientific in so far as it is carried out rigorously, with a concern to recognize and correct error, and with the aim of progressive development of knowledge and refinement of formulation. The dialogic method, as with lower level methods, may therefore be subject to assessment. In this case, its own methods are used on itself, and formal philosophizing is reflexively criticized by an appeal to language, meaning, logical argument and inherent assumptions.

Because the most fundamental assumptions and the very words and sentences being used in pursuit of knowledge may be seized on as objects of uncertainty and inquiry, this inquiring system may be regarded as contributing absolute uncertainty. It therefore counters the intense identification and investment of scientists with their own language and assumptions, and serves as the reservoir of doubt so essential for constructive self-reflection. Dogmatic commitment may develop as a counter-reaction to doubt and this fanaticism is one of the main inherent dangers of Level VI′ inquiry. Believers in philosophical critique not only generate uncertainty but tend to overvalue it, and so may deny that anything can be known. This links to the other inherent danger: the degeneration of inquiry into sterile word play. Popper, for example, has been scathingly critical of scientists or philosophers who ask 'What is ...?' questions [49].

The common criticisms of proper Level VI′ inquiry vary with their source. From scientists working at a practical level, there is often the complaint that the work is divorced from practical reality—a complaint which is equivalent to suggesting that philosophical inquiry should be destroyed or prohibited. Unlike lower level inquiring systems, where scientists, even of differing persuasion, take each other's views into account as possibly offering better explanations, there appears to be considerable internecine strife amongst philosophers who come to radically differing conclusions. The criticism here is that the other group 'lacks a basic understanding' of what is involved. This phenomenon within the Level VI′ inquiring system parallels the hostility amongst the Level VI inquiring systems, which has already been noted.

A common-sense dictum specifies that the dialogic inquiring system ought not to be used for an inquiry which is more appropriately handled at another level. It is necessary therefore to specify the criteria which indicate that Level VI′ inquiry is particularly required. The usual stimulus for such philosophical inquiry is the absence of a framework for addressing important problems. In particular, if there is reason to believe that a major difficulty with problem formulation exists, irrespective of whether the problem is judged to be well- or ill-structured, then philosophical inquiry may be indicated. For example, when an apparently simple and well-structured problem tenaciously resists all efforts at resolution, it may be that the question being asked is based on erroneous assumptions or set in an inappropriate framework.

Philosophical inquiry seems to be stimulated whenever a question touches on issues of identity and self-description. An obvious example is the reaction of many scientists to expound philosophically rather than admit ignorance when their own inquiring system is challenged. Whenever scientists reflect on their own activity they become drawn into philosophical analysis [19, 41, 47]. The identity factor may partly explain why the philosophy of mathematics has been largely neglected by outsiders [9], whereas psychoanalysis, which affects man's view of himself, has attracted substantial external philosophical attention [17, 18, 58].

Level VII′ *inquiring system: the contemplative*

There is a form of inquiry that is both beyond actuality (I′–V′) and beyond rational discourse (VI′), and yet informs and shapes these lower systems. It is used regularly by all serious investigators. It is used prominently and brilliantly by our most creative scientists. Keynes in his essay on Isaac Newton wrote [20]:

> I believe that the clue to his mind is to be found in his unusual powers of continuous concentrated introspection.... His peculiar gift was the power of holding continuously in his mind a purely mental problem until he had seen straight through it.... I believe that Newton could hold a problem in his mind for hours and days and weeks until it surrendered to him its secret. Then being a supreme mathematical technician, he could dress it up, how you will, for purposes of exposition, but it was his intuition which was pre-eminently extraordinary....

This inquiring system, we suggest, should be termed 'contemplative'. Contemplation, argued Aristotle, who of all the ancients most closely embodied the modern dynamic and pragmatic scientific mentality, is 'a laying hold on immortality as far as is possible for men' [3]. The aim in the contemplative method is to obtain a holistic vision, a complete answer to the problem of concern. The result is a theory, from Greek θεωρια = contemplation, speculation, sight. The focus of contemplation is the problem seen as a whole, and the source of certainty resides both in the aesthetic quality or elegance of the solution and the emotional experience of harmony which accompanies resolution. Taken to its logical conclusion, this inquiring system assumes without question that it is possible to construct an account of the world as a whole which will render it completely intelligible. It is clearly an intensely religious attitude, though one entirely divorced from dogma.

In practice, the elements of the solution which emerges for the given problem must be so disposed that the mind can simultaneously appreciate the totality, the details, and how the details inform the totality. Sometimes, to the rational mind running in conventional paths, the result seems wrong or at least counter-intuitive. Kepler, commenting on his new notion of infinity as the second focus of the parabola, said: 'The idea seems absurd, but I can find no flaw in it' [14]. A consequence of this and other properties already described is that the contemplative process, when it succeeds, is accompanied by a sense of absolute certainty. It therefore seems likely that here is the source of faith and the guarantor of the validity of lower levels that Churchman and other philosophers before him have repeatedly recognized and frequently labelled as 'God'.

An assumption underlying the contemplative method, as spelled out by the mathematician Poincare [46], is the existence of a 'subliminal self' which carries out 'unconscious work'. Many creative individuals and those investigating them have come to a similar conclusion [6, 28, 29, 43]. Einstein wrote: 'The words or language, as they are written or spoken, do not seem to play any role in my mechanism of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be 'voluntarily' reproduced and combined.... Conventional words or other signs have to be sought for laboriously only in a secondary state' [11]. Kekule, after much conscious struggle, solved the problem of the structure of the benzene molecule following a dream of a snake taking hold of its own tail [28]. He was probably unaware that this is one of the oldest mystical–religious symbols, the uroboros, which represents the primordial union of man and nature.

The existence of an unconscious realm dominated by images rather than words and with its own sense of direction, though popularized by Freud and Jung, is not new in Western thought [56]. We refer here to Freud's 'unrepressed unconscious' and Jung's 'collective unconscious' rather than to the repressed unconscious generated by emotional trauma [26]. In the unrepressed unconscious, the usual distinctions do not hold. Matte Blanco has characterized as 'symmetrical' the logic used in the unconscious because everything may be taken as identical with everything else [35]; also, and simultaneously, everything may be taken as unique and incommensurable. The unthinkable symmetrical state is the environment (or Level 0′ and VIII′) of the hierarchy of inquiring systems.

An extraordinary methodological assumption in this inquiring system is that truth is immanent in the mind. Not surprisingly the usual devaluing criticism of Level VII′ inquiry is that the output is 'nothing but speculation' and that the accompanying certainty is evidence of personal or professional failure rather than success. Mitroff, for example, found that Apollo scientists working in a speculative–theoretical way were assigned a much higher

status than others despite the intense vitriolic criticism to which their colleagues subjected them [39, Ch.3]. The inherent dangers in Level VII′ inquiry include fixation on an incorrect idea and inappropriate messianism. Speculative ideas are not practically usable until they have been socially shared within the relevant community; and scientific convention attempts to meet this requirement by insisting on the use of inquiring systems at lower levels. A serious danger exists even in the case of a satisfactory scientific product when it is applied outside its area of development and legitimacy. Skinner's work on learning, for example, is inspired and of practical value in a delimited area of human behaviour; but when the same ideas are applied to society as a whole they have little legitimacy and may even be positively dangerous [53]. The indiscriminate transposition of physical science models and methods to provide certainty in social science research is a similar sad and costly example [34, 57].

Scientific progress occurs at this level through holistic syntheses which reframe or redefine the bounds and nature of an area of inquiry. The output therefore is the production of a whole formulation. As indicated above, it is essentially the product of a single individual, though his work can be greatly enhanced and given support and understanding from others within an institution or discipline. All scientists work within a variety of imaginative constructions provided by their forebears which serve as the source of a logically indefensible, but an emotionally and spiritually essential, confidence in the correctness and usefulness of their inquiring activities. Level VII′ formulations have a life-cycle. While nothing may be as powerful as an idea whose time has come, the emergence of a new conception before its time may lead to its neglect or rejection, and ostracism or even persecution of its proponent.

The creative process of preparation, incubation, inspiration, and realization is available to everyone. The benefits and importance of contemplative inquiry are currently being realized in the business environment [15]; and in the philosophy of science, where Feyerabend's epistemological anarchism celebrates the humanitarian and creative element in inquiry [12]. Level VII′ inquiring, being a system, is not haphazard: it has its own rules and requirements [2]; training and facilitation is possible [27, 36, 44]; and the process and its results can be of better or poorer quality. For example, the extent of preparation and the length of time and intensity of incubation affects quality. However, what is most evident and of great social importance is whether the quality of expression of the results permits the holistic and aesthetic nature of the output to be appreciated by others.

A contemplative approach to inquiry is inappropriate when there is much to be done which is immediately useful. In certain situations, however, it might be argued that particular effort needs to be made to support the systematic use of Level VII′ inquiry. It seems particularly necessary when existing accepted ideas have too many obvious anomalies (I′–V′), or too many cogent philosophical objections (VI′). A current example might be research into paranormal and psychical phenomena such as extrasensory perception. The inquiry effort here needs to be pursued by a researcher who is capable of the abandonment of previously held convictions, and who can organize his everyday and mental life to allow concentrated contemplation.

The hierarchy of inquiring systems as a whole

As indicated earlier, individual inquirers typically prefer one or perhaps two of the inquiring systems above the others. However, what the individual prefers differs from what society needs. So the scientific enterprise which institutionalizes inquiring must not promote just one or two methods of inquiring [21]. The methods of logical analysis, data collection and comparing alteratives (Levels I′–III′) are necessary to ground systematic inquiry but are not sufficient in themselves. Inquiring in these modes absolutely requires, consciously or unconsciously, the solid rock of reasonable belief and intuition (Levels VI′–VII′). Mediating between these latter purely mind-based approaches to knowledge and the former concrete approaches to exploration of the real world are dialectical processes and modelling efforts (Levels IV′–V′) which offer challenging stimulation and provide new frameworks by which complexity may be mastered. The present paper is an example of such activity: it offers an encompassing and synthesizing framework (V′), which aims to reconcile disputes amongst scientists and between scientists and practical men (IV′).

All the levels of inquiring system need to be driven by and infused with the contemplative approach (VII′), because this provides the necessary faith which is integral to human inquiry. Scientists are educated to adhere to the prescriptions of lower levels, mainly levels I′, II′ and III′ in the case of the physical and biological sciences. The Level IV′ inquiring system is regarded as legitimate by many social scientists, and is used intuitively, but viewed with discomfort, by natural scientists. The Level V′ inquiring system produces knowledge which is sustained by personal (ethical) commitment, and is therefore essential for the growth of a social science which can influence practitioners. The Level V′ system is also the basis of education [24]. At Level VI′, an inquiring system exists to check the validity of all inquiring systems, but not unnaturally it finds the Level VII′ inquiring system

unmanageable—calls it 'God', denies its existence, or argues that it is beyond study. Such metaphorical throwing of the hands in the air is undesirable. Contemplative methods can be studied and conjectures about the system, such as those produced in this paper, may be useful and are amenable to testing [5].

Hierarchy and homology

Testing is, in essence, an inquiry into inquiry; and this is the logical basis of the nested arrangement. If it is accepted that inquiry is hierarchical, then inquiry into inquiry will also be hierarchical. The inquiring system hierarchy would therefore be expected to be in the image of the originating hierarchy, and parallels are readily noted. For example: Level I forms concepts, while Level I′ depends on ideas; Level II forms things, while Level II′ depends on empirical observation; Level III compares and assigns value or preference, while Level III′ depends on comparing alternatives; Level IV makes comparisons generalizable and precise, while Level IV′ depends on a precise general comparison, the opposite; Levels V and V′ both complete the lower levels reflexively and promote action; Level VI tests the results of inquiry, while Level VI′ tests the very methods of testing by which results are obtained; Levels VII and VII′ are both imaginative, creative and unbounded.

However these parallels or symmetries do not mean that the two hierarchies are homologous, or even if homologous, that they are of identical type. Clearly the two hierarchies are of different types. The framework of inquiry is overtly an integrated and holistic structure, each level heavily and immediately dependent on the others above and below, whereas the various inquiring systems appear as relatively discrete and independent, even antagonistic to each other and anti-hierarchical. This autonomy of inquiring systems may, however, be more apparent than real as all depend on the same framework of inquiry. Scientists overtly operating within any inquiring system implicitly depend on or appeal to others in the course of their work.

Homology is of greater significance than type, because it refers to the identity of whatever constitutes the essence of the superficial phenomena being compared. In this case, the identity (if present) would be based in the abstract properties of the hierarchical structure: the number of levels, the abstract qualities of the levels, and the relation of the various levels to each other. Some of these have been referred to, for example, each structure appears to divide into a lower five-level set of concrete and practical levels and a higher two-level set of abstract and theoretical levels. Such abstract properties are a study in themselves and beyond the scope of this paper. However, the existence of homology can be illuminated, and our present inquiry furthered, by isolating and examining the core testing processes which lie at the heart of the various inquiring systems.

CORE TESTING PROCESSES

The aim of the core testing process (VI) is to produce a generalization grounded in reasonable argument (VI′) which can be *guaranteed to be utterly true* in so far as this is humanly possible and meaningful. The core testing processes can be used to develop generalizations unrelated to the immediate needs of any particular situation in so-called pure inquiry. Pure testing leads to an impressive degree of rigour by restricting the sphere of interest and activity to particular forms of representation, a restriction often not possible or appropriate in the world of human action. Table 2 indicates the usual criticisms and possible dangers (Column 7) and the restriction on applicability (Columns 6 and 8) generated when these core processes are imposed on the world of action. The social world, therefore, is not ideal for generating truth: for example, using knowledge to aid decision-making in a situation is scientifically problematic because situations are then irreversibly altered and checking by replication is impossible.

The philosophical justification for each practical inquiring system is based in the corresponding pure testing process. Making inquiring solely serve the purpose of representing suggests a simple reflexive focus of the pure testing processes on the original framework of inquiry. For each level within the framework, it appears that a core testing process which places utmost faith in that particular level of representation can be developed and articulated. Figure 1 shows the core testing processes in relation to the framework of inquiry as well as to the associated inquiring systems.

The principal characteristics of the varieties (levels) of core testing processes, applicable to both the physical and social sciences, are summarized in Table 3. As noted earlier, it may be misleading, when it is not a matter of epistemological imperialism or political expedience, to use terms that characterize one level at other levels. Language improvement, though difficult and contentious, is important [55], and a possible division of the essential terms used at the various levels is offered. The discussion below assumes conversance with the main issues.

At Level I′, the source of certainty resides in conceptualizing (I). Concepts are defined (or postulated) using other concepts, and axioms are developed based on these. The scientific products

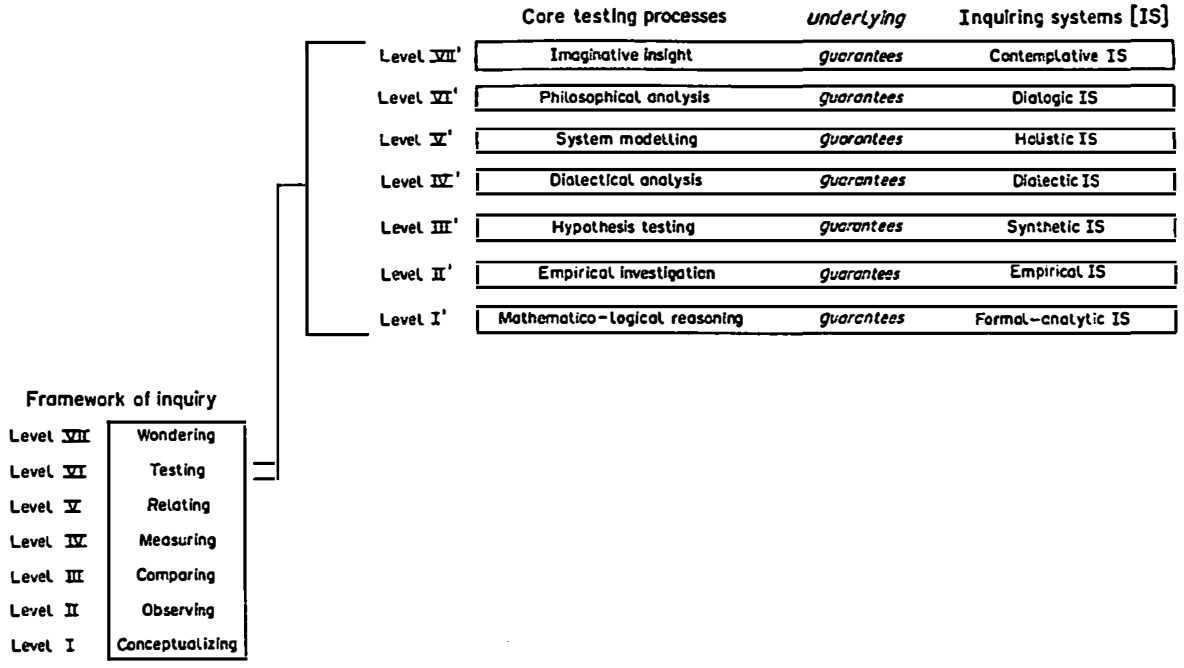

Fig. 1. 'Framework of Inquiry' indicating hierarchical levels and the relation between core testing processes and the practical inquiring systems. Note that the hierarchy of testing processes and corresponding inquiring systems lie wholly within Level VI of the framework and reflect its levels. The framework is in a single box indicating its holistic nature. The inquiring systems are in discrete boxes reflecting their separateness.

which result from manipulating concepts and axioms deductively are called *theorems*. The whole process is termed mathematico-logical reasoning, and a theorem is assessed by criteria of proof. There are a variety of starting points and hence distinct branches of mathematics. Because of the tightly defined tautological framework, a theorem, in principle, is eternal and unchanging—hence the appeal of rationalism as the way to truth. However, Gødel showed that proof is a weaker notion than truth because any complex mathematical system is now known to contain undecidable propositions of undoubted significance [16]. In the associated formal-analytic inquiring system, the use of ideas and reasoning may be forcefully extended e.g. by deducing complex notions like an authority relation from the basic properties of work [42], or by stylizing issues to suit mathematical techniques as in much operational research [13].

At Level II', the source of certainty is facts (II), that is to say, data (Latin: *given*) produced by direct sensory perception. In the process of empirical investigation, data are systematically collected and correlated. Resultant regularities or associations, when generalized using induction, produce a *law*, e.g. Hooke's law, law of multiple proportions. Hence laws, like theorems, are inherent in their origins. The data correlation and the law are assessed by criteria of verification. Laws, once developed, endure—even though the regularity frequently disappears if the conditions vary. The appeal of empiricism as the way to truth rests on its appeal to sacrosanct external facts and their apparent freedom from subjective imposition or distortion. In the associated empirical inquiring system, the use of facts may be forcefully extended beyond what is obviously given by sensory perception, e.g. in much organization research facts may be constructed rather than sensed, and even apparently straightforward data may be disputed [50].

At Level III', the source of certainty resides in comparing alternatives (III). Data are not simply given by the world, but taken from it on the basis of explicit or implicit concepts—*capta* might be a better term [30]. However these concepts are also not simple, being themselves abstracted from observations and experience. Specified observations (or 'variables') are therefore regarded as 'indicators' of 'constructs' which are themselves unreachable. In the process of hypothesis testing, alternative explanations or conjectures are entertained and evidence is produced as to which description of the world is preferable. The product of such inquiry is called a *theory*. Theories are changeable, and an important criterion as to whether a general proposition is a theory or not lies in the possibility of falsifying it. However, because theories are both inherent in reality (due to their fact base) and imposed upon it (by their explanatory quality), decisive falsification is no easy matter. The indices or controls used in falsification may always be chal-

Table 3. Abstract characteristics of the core testing processes, most clearly manifest in inquiry divorced from practical application

Level	Process	Key activity (verb)	Key activity (object)	Means	Product (generalization)	Assessment of the product	Product : Process relation
I′	Mathematico-logical reasoning	Defining	Concepts	Axioms	Theorem	Is it proven?	Inherent within
II′	Empirical investigation	Correlating	Data	Sensory perception	Law or Association	Is it verified?	Inherent with
III′	Hypothesis testing	Comparing	Alternative possibilities	Indicators and controls	Theory	Is it falsifiable?	Inherent within and imposed upon
IV′	Dialectical analysis	Developing and reconciling	Thesis–Antithesis (opposites)	Syntheses	Principle	Does it resolve?	Imposed upon
V′	System modelling	Inter-relating	System of elements	Structuring into and within levels	Model	Does it represent?	Imposed upon
VI′	Philosophical analysis	Ratiocinating	Key ideas	Rules of rational discourse	Conclusion	Is it reasonable?	Imposed upon and inherent within
VII′	Imaginative insight	Contemplating	Unbounded totality	Identity of mind and universe	Revelation or Insight	Is it inspired?	Identity (distinction not recognized)

lenged and auxiliary explanations developed for results. The paradox at this level is that certainty is increased—paralleling the increased certainty of Level III representation—but only by abolishing any guarantee of truth. As Popper puts it: 'The empirical basis of objective science has then nothing "absolute" about it. ... The bold structure of its theories rises, as it were, above a swamp' [48, p. 111]. Although error is now guaranteed, reality may be approached in a piecemeal evolutionary fashion. In the associated synthetic inquiring system, the use of comparisons may be forcefully extended to complex alternatives such as different ways of running a hospital, or even a national economy, where controls and indicators are difficult if not impossible to establish with confidence.

Hypothesis testing (III′) is now believed to be the cornerstone of modern scientific method. However, because many scientists do not naturally incline to the 'method of multiple working hypotheses' [7], they must present a facade of hypothesis testing while engaged in other modes of inquiry, most commonly objective fact-finding(II′) or the defense of an embattled theoretical position (v.i. IV′). This may be due to explanation and hypothesis testing, like comparing (III), being inherently subjective. The subjectivity of hypothesis testing resides in such personal decisions as selecting which questions are soluble, which conjectures deserve testing and which data require notice. These decisions depend in the end on the scientists's judgement or 'personal skill' [47].

The next level approach is dialectical analysis (IV′), which, like measurement (IV), is based on a precise, stringent and general form of comparison and can be developed objectively in relation to any generalization under scrutiny. The comparison, which serves as the source of certainty in this inquiring system, is the alternative which is precisely the opposite of the generalization—and therefore is recognizable within it. The inquiring process here demands first, the development or recognition of a conflict between a generalization, called a *thesis*, and its opposite, called the *antithesis*; and then a *synthesis* of these opposites via the development of a new *principle*. This principle is itself a thesis and the process potentially repeats itself leading to growth of knowledge. Principles are imposed on the thesis–antithesis and, if they resolve the conflict by their strength and appeal, they endure, even when superseded by new syntheses. For example, the conflict between hereditary and environmental effects on individuals, both forceful and fruitful theses (theories at Level III′), has been superseded by interactional conceptions. However the conflict between physical and emotional (or personal) bases of mental illness has not been synthesized. Which

side is taken in the battle between thesis and antithesis depends on personal preference, need, and intuition; and also on the elegance and economy of the arguments. Observation is irrelevant except in so far as it is shaped and selected for the preferred thesis. The researcher finds that support for either one of the opposing conceptions has implications for funding and for his career and professional relationships. Opposing scientific conceptions, even when concerned with purely physical phenomena like light or the origin of the Universe, develop cultural value as source metaphors for use in society at large. In other words, *values play as large a part in physical science as social science, but they are minimized in the former because they are not the subject of inquiry*. In the associated dialectical inquiring system, the ideas in conflict may be too rapidly identified with the values of individuals and groups, rather than seen as opposed in themselves. Synthesis and consensus in this case often develops by formulating a compromise, rather than by developing an encompassing principle.

At Level V′, the source of certainty resides in relations (V). Inter-relations are identified, and these create a hierarchic structure composed of the elements in the relations and the whole formed by the relations. This whole is termed a system, and the process of inquiring is termed system modelling. The scientific product is a *model* which aims to represent the structure of relationships. Models like theories change over time, sometimes rapidly as previously ignored factors demand inclusion. System modelling is reflexive in that it may operate within any one of the lower levels, e.g. it is meaningful to speak of modelling a system of mathematics, or of developing an empirical model; or a model may use a mixture of concepts, data, laws, theories and principles, e.g. modelling the past and future development of the Universe [4]. In modelling, a system is imposed on the elements and relations. Because reality is believed to inhere within systems, the elements themselves are regarded as systems, and the system itself is regarded as an element of a higher-order system. The end result is an urge to sweep in variables and attempt to model a completely inter-connected reality as an ultimate system of systems. This is the vision presented by Churchman as Singerian inquiry, and the basis of ideological claims to scientific supremacy by many adherents to system theory [33]. System modelling might be considered to be best suited to handling the real world, because the real world is dealt with via representation, and only system modelling supports all varieties of representation. However, system modelling is vulnerable to omission of key elements. Despite the efforts of workers like Ackoff and Churchman, human intention, feeling and meaning are crucial elements, largely alien to the origins of systems analysis and systems design, which still tend to be bypassed in the associated holistic–interdisciplinary inquiring system.

At Level VI′, the source of certainty resides in the act of testing itself (VI), that is to say, in a framework of fundamental assumptions provided by rational discussion. Inquiring is carried out by a process of philosophical analysis, much as described earlier. The key activity is one of ratiocination and discourse, based on the assumption that in the end the human mind can, indeed must, comprehend reality. The products of ratiocination are *conclusions*, which are judged reflexively according to whether they are reasonable. Conclusions are imposed on reasoning, and yet believed to be inherent in it. Hence the major conclusions of philosophy are perennial. Even when proved incorrect or partial, they are useful objects of study, exemplifying a world-view and indicating the errors into which a reasonable person may fall. Just as other levels contain aspects of lower levels suitably modified, so philosophical analysis can be recognized as based in analytical (rationalist), empirical, synthetic, dialectic or systemic assumptions and methods, or some combination of these.

Philosophical analysis may be reflexively turned on to the systems of pure inquiring themselves, because each represents a fundamental world-view. Such a reflection generates a nested hierarchy within Level VI′ which homologously parallels the nested hierarchy within Level VI. The reflection appears to generate the principal divisions of pure philosophy, which are distinct from applied or practical philosophy discussed earlier. These divisions may be briefly summarized as follows:

> Level I′ inquiring when subject to philosophical ratiocination leads to statements about the nature of being, i.e. generates *metaphysics*. Scrutiny of Level II′ assumptions poses important questions of how we can be sure that a sense impression is what it appears to be, i.e. it provides the impetus for *epistemology*. The relation between the realms of ideas (I) and of things (II) and the validity of structures that mediate such relations, assumed at Level III′, is the subject matter of *ontology*. Scrutiny of Level IV′ assumptions leads to questioning the bases of adherence to any thesis and the criteria for developing conflict or judging its resolution, all of which are matters of social and personal value, i.e. rooted in *aesthetics*. Level V′ assumptions of complete interrelationship and a systematic comprehension of totality leads to questions of intervention and hence to *ethics*. Scrutiny of Level VI′ assumptions leads to the study of language and argument or *formal philosophy*, to which much modern philosophy has retreated. Finally scrutiny of Level VII′ assumptions leads to *mystical philosophy*, most noticeable in oriental philosophies such as Taoism and Buddhism, which comprise descriptions of the direct experience of the nature of enlightenment and its implications for being, knowing, living, valuing, thinking, relating and other aspects of existence.

At Level VII′, the source of certainty rests in the imaginative process itself, which involves sustained

identification of the inquirer with an unbounded totality. The underlying assumption is that the mind is identical to the universe; and hence the whole or any part of the Universe can be comprehended by entering the proper state of mind. The product may be referred to as a *revelation* or *enlightenment* or more colloquially as a 'flash of insight'. A flash needs to be assessed in its own terms, that is to say according to whether or not it is indeed inspired or no more than an act of self-delusion removing confusion and doubt but contributing nothing. The emergence of inspired awareness is not uncommon in scientific endeavour, but after subsequent testing and digesting at lower levels, it tends to become lost to view or taken for granted. Not uncommonly it forms the 'metaphysical theory' or 'hard core' of a research programme which is resistant to modification whatever the results of empirical inquiry [31].

CONCLUSION

This paper follows on from 'Measurement and the structure of scientific analysis' [23]. It is based on an earlier appreciation [21] of Churchman's pioneering work on inquiring systems and a wish to clarify, integrate and forward his ideas. Because representing the world through knowledge cannot be separated from the inquiring activity itself, it was argued that the five-level system of knowledge formation previously offered, though whole, was incomplete. It was then proposed that the five-level system was part of a larger seven-level hierarchy in which the upper two levels of testing (VI) and wondering (VII) stimulate, direct and check representational activity. As all levels are forms of inquiring, the total has been called the framework of inquiry.

Churchman's inquiring systems have been logically placed within Level VI of the framework of inquiry and two further and evidently higher-level inquiring systems, previously implicit, have been added explicitly: the dialogic ($VI^{VI'}$) and the contemplative ($VI^{VII'}$). These two levels provide a definitive location for doubt and faith respectively. Inquiring in the context of action and decision, the case assumed by the inquiring systems, draws its justification from core testing processes which are most evident when inquiring is carried out solely to represent. These core testing processes can be shown to emerge by successive dependence on each level of the framework of inquiry. This imparts the hierarchical organization to the inquiring systems, previously assumed or felt but not clearly demonstrated.

A basic homology between the two hierarchies has been proposed and illustrated, but not demonstrated fully. As an example, the twin uniquely human qualities of reason and imagination have been formally located within the two highest levels of both hierarchies, stimulating and guiding practical action at lower levels and thereby providing hope for the creation of a worthwhile future.

Acknowledgements—This paper would not have been written without the stimulation of Stephen Sinnott and the general assistance, persistent encouragement and critical comments of Ralph Rowbottom. In addition, Jimmy Algie provided helpful clarification on a number of points.

REFERENCES

1. G. S. Altshuller, *Creativity as an Exact Science*. Gordon & Breach, New York (1983).
2. S. Arieti, *Creativity: The Magic Synthesis*. Basic Books, New York (1981).
3. Aristotle, *The Complete Works* (Edited by J. A. Smith and W. D. Ross). Clarendon Press, Oxford (1908–1952).
4. J. D. Barrow and F. J. Tipler, *The Anthropic Cosmological Principle*. Clarendon Press, Oxford (1986).
5. T. Bastick, *Intuition: How We Think and Act*. John Wiley, New York (1982).
6. J. Bruner, *On Knowing: Essays for the Left Hand*. Harvard University Press, Cambridge, MA (1966).
7. T. C. Chamberlin, The method of multiple working hypotheses. *Science* 148 (1965), 754–759.
8. C. W. Churchman, *The Design of Inquiring Systems*. Basic Books, New York (1971).
9. P. J. Davis and R. Hersh, *The Mathematical Experience*. Birkhauser, Boston, MA (1980).
10. H. L. Dreyfus, *Mind Over Machine*. Free Press, New York (1986).
11. A. Einstein, Letter to Jacques Hadamard. In J. Hadamard (ed.), *The Psychology of Invention in the Mathematical Field*. Princeton University Press, Princeton, NJ (1945).
12. P. Feyerabend, *Against Method: Outline of an Anarchistic Theory of Knowledge*. Verso, London (1978).
13. S. French, R. Hartley, L. C. Thomas and D. J. White, *Operational Research Techniques*. Edward Arnold, London (1986).
14. R. W. Gerard, The biological basis of the imagination. *The Scientific Monthly* June, 1946.
15. C. R. Hickman and M. A. Silva, *Creating Excellence*. Unwin, London (1985).
16. D. R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid*. Harvester Press, London (1979).
17. S. Hook (ed.), *Psychoanalysis: Scientific Method and Philosophy*. New York University Press, New York (1959).
18. G. N. Izenberg, *The Existentialist Critique of Freud: The Crisis of Autonomy*. Princeton University Press, Princeton, NJ (1976).
19. J. Jeans, *Physics and Philosophy*. Cambridge University Press, London (1942).
20. J. M. Keynes, Newton the man. In G. Keynes (ed.), *Essays in Biography*. Hart-Davis, London (1951).
21. W. Kinston, Pluralism and the organization of health services research. *Social Sci. Med.* 17 (1983), 299–313.
22. W. Kinston, Hospital organization and structure and its effect on inter-professional behaviour and the delivery of care. *Social Sci. Med.* 17 (1983), 1159–1170.
23. W. Kinston, Measurement and the structure of scientific analysis. *Syst. Res.* 2 (1985), 95–104.
24. W. Kinston, The essence of holistic inquiry. Discussion document, Brunel University, Uxbridge, U.K. (1985).
25. W. Kinston and J. Algie, The seven paths of decision. Discussion Document, Brunel University, Uxbridge, U.K. (1986).
26. W. Kinston and J. Cohen, Primal repression: Clinical

and theoretical aspects. *Internat. J. Psychoanal.* 67 (1986), 337–355.
27. D. Koberg and J. Bagnall, *The Universal Traveler. A Soft-Systems Guidebook to Creavity, Problem Solving and the Process of Design.* William Kaufmann, Los Altos, CA (1974).
28. A. Koestler, *The Act of Creation.* Dell, New York (1967).
29. L. Kubie, *Neurotic Distortion of the Creative Process.* Farrar, Straus & Giroux, New York (1966).
30. R. D. Laing, *The Politics of Experience and The Bird of Paradise.* Penguin Books, Harmondsworth, U.K. (1967).
31. I. Lakatos, Falsification and the methodology of scientific research programmes. In I. Lakatos and A. Musgrave (eds), *Criticism and the Growth of Knowledge.* Cambridge University Press, London (1970).
32. C. S. Levy, *Social Work and Social Philosophy: A Guide for Practice.* Routledge Kegan Paul, London (1985).
33. R. Lilienfeld, *The Rise of Systems Theory: An Ideological Analysis.* John Wiley, New York (1978).
34. C. Lindblom and D. K. Cohen, *Usable Knowledge: Social Science and Social Problem Solving.* Yale University Press, New Haven, CT (1979).
35. I. Matte Blanco, *The Unconscious as Infinite Sets.* Duckworth, London (1975).
36. R. McKim, *Experiences in Visual Thinking.* Brooks/Cole, Monterey, CA (1972).
37. P. B. Medawar, *The Art of the Soluble.* Methuen, London (1967).
38. I. I. Mitroff, Epistemology as general systems theory: An approach to the conceptualization of complex decision-making experiments. *Phil. Soc. Sci.* 3 (1973), 117–134.
39. I. I. Mitroff, *The Subjective Side of Science.* Elsevier, Amsterdam (1974).
40. I. I. Mitroff and F. Betz, Dialectical decision theory: A meta-theory of decision-making. *Mgmt Sci.* 19 (1972), 11–24.
41. J. Monod, *Chance and Necessity* (transl. A. Wainhouse). Alfred A. Knopf, New York (1971).
42. A. D. Newman and R. W. Rowbottom, *Organization Analysis.* Heinemann, London (1968).
43. R. E. Ornstein, *The Psychology of Consciousness.* W. H. Freeman, San Francisco, CA (1972).
44. A. Osborn, *Applied Imagination.* Charles Scribners, New York (1953).
45. E. D. Pellegrino and D. C. Thomasma, *A Philosophical Basis of Medical Practice: Toward a Philosophy and Ethic of the Healing Professions.* Oxford University Press, New York (1981).
46. H. Poincare, Mathematical creation. In *The Foundations of Science* (1913) (Transl. G. B. Halsted). Science Press, New York (1946).
47. M. Polanyi, *Personal Knowledge.* Routledge Kegan Paul, London (1962).
48. K. R. Popper, *The Logic of Scientific Discovery.* Hutchinson, London (1972).
49. K. R. Popper, *Conjectures and Refutations* (5th edn). Routledge Kegan Paul, London (1974).
50. N. V. Raynes, M. W. Pratt and S. Roses, *Organisational Structure and Care of the Mentally Handicapped.* Croom Helm, London (1979).
51. M. Ruse (ed.), *Biology and Philosophy.* A Quarterly Journal from Reidel, Amsterdam.
52. E. A. Singer. Jr, In C. W. Churchman (ed.), *Experience and Reflection.* Univeristy of Pennsylvania Press, Philadelphia, PA (1959).
53. B. F. Skinner, *Beyond Freedom and Dignity.* Cape, London (1972).
54. J. Warfield, *Societal Systems.* John Wiley, New York (1976).
55. J. Warfield and A. N. Christakis, Dimensionality. *Syst. Res.* 4 (1987), 127–137.
56. L. L. Whyte, *The Unconscious Before Freud.* Basic Books, New York (1960).
57. P. Winch, *The Idea of a Social Science and its Relation to Philosophy.* Routledge Kegan Paul. London (1958).
58. R. Wollheim, *The Thread of Life.* Cambridge University Press, London (1984).